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GEOLOGICAL SURVEY

SELECTED WATER RESOURCES ABSTRACTS

MARCH 3, 1849

VOLUME 19, NUMBER 1
JANUARY 1986

W86-00001 -- W86-00307
CODEN: SWRABW

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SELECTED
WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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JANUARY 1986

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MARCH 3, 1849

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

SPATIALLY VARYING RAINFALL AND FLOODRISK ANALYSIS,

Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 2E.
W86-00012

NONLINEAR TIME-VARIANT CONSTRAINED MODEL FOR RAINFALL-RUNOFF,

Arkansas Univ., Fayetteville. Engineering Experiment Station.
B. Datta, and D. P. Lettenmaier.
Journal of Hydrology, Vol. 77, p 1-18, 1985. 3 Fig, 7 Tab, 11 Ref. State of Washington Water Research Center project C-00234.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Constrained linear system model, *Nonlinear models, Hydrologic models, Precipitation, Runoff, Mathematical studies, Statistical analysis, Hydrologic models.

Models of the rainfall-runoff process can be segregated into two classes: those based on input-output (black box) techniques, and those based, directly or indirectly, on the laws of physics. Both approaches have limitations and advantages. A combined model was developed which incorporates an approximated description of the physical process to estimate effective precipitation and uses the input-output estimation procedure of the constrained linear system (CLS) model to relate effective precipitation to runoff. Certain problems of poor calibration and prediction encountered with the CLS model were significantly reduced by using estimated effective precipitation in place of actual precipitation. Use of the precipitation preprocessor with the CLS runoff model effectively incorporates nonlinear and time-variant dynamics without the necessity for multiple-parameter vectors and antecedent precipitation thresholds required by the original version of CLS. Additional refinements, including time variability of some of the parameters, can easily be accommodated in the new formulation. (Author's abstract)
W86-00022

VARIOGRAM IDENTIFICATION BY THE MEAN-SQUARED INTERPOLATION ERROR METHOD WITH APPLICATION TO HYDROLOGIC FIELDS,

Centre National de la Recherche Scientifique, Grenoble (France). Inst. de Mecanique de Grenoble.
T. Lebel, and G. Bastin.
Journal of Hydrology, Vol. 77, p 31-56, 1985. 10 Fig, 10 Tab, 23 Ref.

Descriptors: *Variograms, *Mean squared interpolation error method, *Interpolations, *Hydrologic models, Model studies, Hydrologic data, Interpolation errror, Statistical analysis.

Real-life applications of BLU (best linear unbiased) interpolation in random fields, require, in most cases, a preliminary identification of a parametric model for the variogram of the field of interest. The variogram identification can be performed by minimizing a functional of a set of observed interpolation errors; the 'mean squared interpolation error' (MSIE) method is such a method for variogram identification. A theoretical analysis of the MSIE method was performed under the realistic assumption that the parametric variogram model is only an approximation of the true-field variogram. A general asymptotic property was demonstrated which does not require any specific assumption on the probability density of the field. In a piezometric field application, the variogram model was a basic tool for the contour mapping of the water level. The MSIE criterion is an efficient tool to discriminate between alternative variogram models and, in this case with scarce data, *the models* obtained with the MSIE method can differ substantially from those derived from the experimental variogram: a theoretical analysis of the robustness of the various identification methods with small data sets would be very useful. In a rainfall field application, the variogram model was needed to calculate mean areal rainfall variances and mean areal GRADEX. A global climatological variogram was identified: a very large data set was available and the best model was very close to the experimental variogram. An interesting cross-validation result is that the parameter estimates obtained from two subsamples of the complete data set are very close. (Collier-IVI)
W86-00024

REGIONAL FREQUENCY ANALYSIS OF MULTIYEAR DROUGHTS USING WATERSHED AND CLIMATIC INFORMATION,

Montgomery (James M.), Inc., Salt Lake City, UT.
E. G. Paulson, Jr., J. Sadeghipour, and J. A. Dracup.
Journal of Hydrology, Vol. 77, p 57-76, 1985. 1 Fig, 4 Tab, 31 Ref. NSF grant 77-11137 and University of California Water Resources Center grant W-615.

Descriptors: *Frequency analysis, *Droughts, *Climatology, *Statistical analysis, *Central Valley, *California, Meteorological data, Multiple regression analysis, Regression analysis, Streamflow, Data interpretation.

A regional frequency analysis of hydrologic multiyear droughts was performed using multiple linear regression to estimate characteristics of drought severity, magnitude and duration from indices of watershed geomorphology, and climate. Thirteen characteristics of drought severity, magnitude and duration were used as dependent variables; eleven indices of watershed geomorphology and meteorology were used as independent variables. Reasonable estimation accuracy was obtained utilizing Central Valley of California, U.S.A., streamflow data (mean standard errors between 14% and 41%). The proposed regression relations are primarily statistical models, and are not necessarily reliable indicators of cause-and-effect physical relationships. (Author's abstract)
W86-00025

STATISTICAL CHOICE OF EXTREMAL MODELS FOR COMPLETE AND CENSORED DATA,

Agricultural Univ., Wageningen (Netherlands). Dept. of Mathematics.
M. A. J. Van Montfort, and M. I. Gomes.
Journal of Hydrology, Vol. 77, p 77-87, 1985. 3 Fig, 2 Tab, 10 Ref, 1 Append.

Descriptors: *Statistical analysis, *Mathematical studies, *Extremal models, *Censored data, Data interpretation, Hydrologic data, Model studies, Probability distribution.

Often one of the three well-known limiting distributions of univariate extremes, e.g. maxima of riverflow or precipitation, is successfully fitted to the data, and the estimated values corresponding to given return periods calculated. Within the framework of the general extreme-value distribution (GEV, with shape parameter Theta), which combines the Frechet (Theta < 0), Gumben (Theta = 0) and Weibull types (Theta > 0), the power functions of some statistics for rejecting the Gumbel distribution (Theta = 0) were compared. Often in checking the suitability of a distribution, a goodness of fit test is used involving the whole range of the distribution while the valid interest is in one tail only. The interest in whether Theta deviates from zero arises when one is concerned with the value of a variate corresponding to a return period nearly equal to the length of the sample. The conditions for adequate behavior in the right-hand tail are not always the same as for the left-hand tail, and lack of fit in the left-hand tail should not influence inferences concerning the right-hand tail. It is necessary to consider the loss *in power of tests for rejecting Theta = 0 in left-*hand censored samples, where the observations with a rank lower than a specified value are missing. (Collier-IVI)
W86-00026

DISCRETE-TIME LINEAR CASCADE UNDER TIME AVERAGING,

National Hydrology Research Inst., Ottawa (Ontario).
V. Klemes, I. Klemes, and J. E. Glynn.
Journal of Hydrology, Vol. 77, p 107-123, 1985. 5 Fig, 13 Ref, 1 Append.

Descriptors: *Streamflow, *Model studies, *Linear cascades, *River basins, Stochastic process, Basin storage, Hydrologic models.

A cascade of linear reservoirs defined in discrete time has been suggested as a lumped conceptual model for a river basin for the case when the streamflow (basin output) at a control point is represented by an autoregressive time series in which the (uncorrelated and identically distributed) random component represents the time series of net basin input, i.e. roughly speaking, of precipitation minus evapotranspiration. An attempt has been made to find out whether the relationship between the total gravity storage of a basin and its runoff, whose empirical determination is within the reach of hydrologic analysis, can be used to test the assumption of linearity of a discrete-time stochastic hydrologic model. A theoretical investigation of the relationship between the total storage in a discrete-time linear cascade and the output at time t, and between averages of these two variables over T consecutive times, is examined. (Baker-IVI)
W86-00028

COMPARISON OF TWO DAILY STREAMFLOW SIMULATION MODELS OF AN ALPINE WATERSHED,

Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
For primary bibliographic entry see Field 2E.
W86-00033

DETERMINATION OF RESISTANCE PARAMETERS OF PLUVIO-NIVO-GLACIAL ALPINE SYSTEMS BY MATHEMATICAL MODELING OF RUNOFF,

Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
For primary bibliographic entry see Field 2E.
W86-00034

MULTIPLE NONLINEAR STATISTICAL MODELS FOR RUNOFF SIMULATION AND PREDICTION,

Alcoa of Australia Ltd., Applecross.
For primary bibliographic entry see Field 2E.
W86-00035

EFFECTS OF INCORRECTLY REMOVED PERIODICITY IN PARAMETERS ON STOCHASTIC DEPENDENCE,

George Washington Univ., Washington, DC. International Water Resources Inst.
V. Yevjevich, and J. T. B. Obeysekera.
Water Resources Research, Vol. 21, No. 5, p 685-690, May, 1985. 6 Fig, 2 Tab, 7 Ref. NSF grant CEE-7916817 and CEE 84-05289/85-41631.

Descriptors: *Hydrologic time series, *Stochastic hydrology, *Time series analysis, Mathematical studies, Seasonal variation, Model studies, Harmonics.

Most hydrologic time series are periodic-stochastic processes in which the stochastic component is mixed with periodic parameters. Modeling of seasonal hydrologic time series often requires the identification of periodic functions of its basic parameters such as the mean, standard deviation, and autocorrelation coefficients. The consequences of incorrect estimation of harmonics on dependence models of the stochastic component are investigated. For each underestimated harmonic in the periodic mean the stochastic nonstationary dependence models will have four additional terms, with four coefficients to be estimated instead of only two in the harmonic. For each overestimated harmonic in the mean two additional coefficients must be esti-

mated, with a slight effect on estimated coefficients of dependence models and a practically negligible effect on model identification. If one has to select between underestimation or overestimation, the penalty is smaller for the case of overestimation of harmonics in the mean. The identification of the dependence model of the stochastic component is not significantly affected either by underestimation or overestimation. A neglect of periodicity in autocorrelation coefficients leads to inferences of incorrect stationary stochastic dependence models, while in reality they are nonstationary. (Baker-IVI)
W86-00075

SYNTHESIS OF RADAR RAINFALL DATA,

National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
W. F. Krajewski, and K. P. Georgakakos.
Water Resources Research, Vol. 21, No. 5, p 764-768, May 1985. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Rainfall, *Radar, Rainfall-runoff relationships, Model studies, Hydrologic models, Simulation, Rain gages, Mathematical studies.

Procedures are being developed to merge radar and rain gage observations, to obtain the best estimate of the rainfall field, taking advantage of the spatial detail that the radar gives and of the high point accuracy of the gages. Reliable synthesis of radar-rainfall fields can be useful for validation as an alternative to field experiments. A method of generating synthetic radar-rainfall data is described. The data are generated by imposing random noise on a given, high-quality radar-rainfall field. Certain conditions are imposed on the resultant rainfall field so that the noise parameters are prespecified. In that way nonstationary nonergodic fields can be simulated. Since the original and the observation (original and noise) fields are known, the method can be used in the validation procedures of various hydrologic models (radar and rain gage data merging, mean areal precipitation estimation, rainfall-runoff). The example given shows that the accuracy of the preservation of the required statistics is very good, especially for realistic values of the variance measure, even for a relatively small number of realizations. The method proposed is flexible in that one can generate fields with a wide range of second order statistics from one high quality radar field. When the technique is used to investigate radar and rain gage data merging, a procedure is required to synthesize the gage data. (Baker-IVI)
W86-00084

ATTEMPT TO IMPLEMENT SWMM IN TUNISIA,

Lund Univ. (Sweden).
For primary bibliographic entry see Field 6A.
W86-00087

DATA MANAGEMENT FOR CONTINUOUS HYDROLOGIC SIMULATION,

North Carolina Univ. at Charlotte. Dept. of Urban and Environmental Engineering.
J. S. Wu.
In: Proceedings of Stormwater and Water Quality and Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 161-176, 11 Fig, 6 Tab, 4 Ref.

Descriptors: *Rainfall-runoff relationships, *Rainfall, *Runoff, *Agricultural watersheds, *Hydrologic models, *Model studies, *Regression analysis, *Watershed management, *Agricultural runoff, Evapotranspiration, Models, Watersheds, Groundwater recharge, Soil water, Simulation analysis.

The U.S. EPA's Agricultural Runoff Model (ARM) was applied to the continuous hydrologic simulation of one of the agricultural watersheds of the Chowan River Basin in North Carolina. Regression analysis was employed to generate missing rainfall-runoff data required for calibration of the ARM model. Monthly rainfall, evapotranspiration and runoff data served as model input data and output data consisted of monthly rainfall, runoff, evapotranspiration, soil moisture changes, and groundwater recharge. Model simulations agreed well with per storm comparisons and recorded hydrographs and demonstrated the successful calibration for the Cutawhiskie site of the watershed. With a good data-base for calibration and verification, the continuous hydrological simulation model can be a useful tool for evaluating the effectiveness of watershed management practices over an extended period of time.
W86-00093

SNOWMELT INDUCED URBAN RUNOFF IN NORTHERN SWEDEN,

McMaster Univ., Hamilton (Ontario).
For primary bibliographic entry see Field 2C.
W86-00097

STORM SEWER OPTIMUM DESIGN,

For primary bibliographic entry see Field 8B.
W86-00100

ATCHAFALAYA RIVER DELTA; REPORT 8: NUMERICAL MODELING OF HURRICANE-INDUCED STORM SURGE,

Coastal Engineering Research Center, Vicksburg, MS.
B. A. Ebersole.
Technical Report HL-82-15, January 1985. Report 8 of a Series. 94 p, 61 Fig, 6 Tab, 21 Ref.

Descriptors: *Mathematical models, *Simulation analysis, *Hydrodynamics, *Hurricanes, *Tidal hydraulics, Models, Model studies, Numerical analysis, Mathematical studies, Bays, Tides, Storm surges, Storm tides, Hydraulic models.

The U.S. Army Engineer Waterways Experiment Station Implicit Flooding Model (WIFM) was applied to the Atchafalaya River Delta Project. This numerical model was used to simulate the hydrodynamics within the bay resulting from astronomical and/or meteorological forcing. The WIFM model solves finite difference approximations of the governing equations on a grid mesh of fixed spatial extent for a finite number of constant time increments, utilizing an alternating-direction, implicit solution scheme. The accuracy of the model was verified using a comparison of observed and simulated water elevations. Comparisons showed that the model can accurately simulate the response of the system to the astronomical tide and hurricanes. In the case of tides alone, errors were very small. However, in the storm surge applications, errors were larger. Using the verified model, a set of hypothetical storms was simulated. Dynamical characteristics of these storms reflect hurricanes that have occurred in this area in the past. Hydrodynamics from these storms will be used in other tasks to investigate the response of the Atchafalaya River delta growth to extreme meteorological events.
W86-00164

HYDROLOGICAL YEARBOOK: 1980.

Reeve (Douglas) and Associates, Toronto (Ontario).
Publications of the Water Research Institute, No. 53, 1983. 174 p, 2 Maps, 7 Append.

Descriptors: *Watersheds, *Hydrologic data collections, *Precipitation, *Runoff, *Floods, Finland, Groundwater, Rivers, Water level, Ice, Snow cover, Water temperature, Temperature, Hydrographs, Lakes, Frost, Water storage.

Hydrological statistics for Finland are reported. At the beginning of 1980 water storage was average for the season. Toward the end of the year storage was exceptionally low in the north and plentiful in the south. A 100-yr flood for autumn occured in the Aurajoki in late November; other rivers flooded during this time. At the end of the year record snow cover, up to 150 mm of water in some places, was on the ground. Tables and hydrographs include data on water levels and stages, discharge, maps of hydrological basins, runoff, areal precipitation and water equivalent of snow cover, evaporation, surface temperature of open waters, dates of freeze-up and ice breakup, ice cover thickness, ground frost, and groundwater.
W86-00182

HYDROLOGICAL SIMULATION PROGRAM--FORTRAN (HSPF): USERS MANUAL FOR RELEASE 8.0,

University of the Pacific, Stockton, CA.
R. C. Johanson, J. C. Imhoff, J. L. Kittle, and A. S. Donigan.
EPA-600/3-84-006, June 1984. Environmental Protection Agency, Athens, GA. 767 p, 138 p, 49 Ref, 5 Append. Contract/Grant No. 68-01-6207.

Descriptors: *Hydrologic models, *Model studies, *Computer programs, Streams, Lakes, Hydrological Simulation Program--FORTRAN, Water quality, Water supply, Rainfall-runoff relationships, Data processing, Fortran.

The Hydrological Simulation Program--FORTRAN (HSPF) is a set of computer codes that can simulate the hydrologic, and associated water quality, processes on pervious and impervious land surfaces and in streams and well mixed impoundments. The manual discusses the modular structure of the system, the principles of structured programming technology and the use of these principles in the construction of the HSPF software. In addition to a pictorial representation of how each of the 500 subprograms fits into the system, the manual presents a detailed discussion of the algorithms used to simulate various water quality and quantity processes. Data useful to those who need to install, maintain, or alter the system or who wish to examine its structure in greater detail also are presented. (Author)
W86-00199

2B. Precipitation

STATISTICAL ANALYSIS OF PRECIPITATION FREQUENCY IN THE CONTERMINOUS UNITED STATES, INCLUDING COMPARISONS WITH PRECIPITATION TOTALS,

Midwest Research Inst., Kansas City, MO.
P. J. Englehart, and A. V. Douglas.
Journal of Climate and Applied Meteorology, Vol. 24, No. 4, p 350-362, April, 1985. 7 Fig, 5 Tab, 32 Ref. NSF grant ATM-8219370.

Descriptors: *Statistical analysis, *Total precipitation, *Precipitation frequency, *Weather data collections, Data interpretation, Spatial distribution, Temporal distribution.

An alternative measure of time-aggregated precipitation for use in short-term climate studies was developed; this measure, precipitation frequency, is defined as the number of days per month or season with total amounts > or = 2.54 mm (0.10 inch). Newly created data sets for the period 1951-80 were used as a basis for describing large-scale spatial and temporal features of precipitation frequency for the mainland United States. Comparisons between precipitation frequency and the conventional statistic, total precipitation, indicate that frequency is more normally distributed and more spatially coherent than total precipitation. Factor analysis and an orthogonal rotation to the varimax criterion identify synoptic-scale, spatially coherent regions of precipitation frequency. The regions are generally consistent with previously documented cyclone trajectories. (Author's abstract)
W86-00020

SOIL MOISTURE CONTENT: STATISTICAL ESTIMATION OF ITS PROBABILITY DISTRIBUTION,

Kozponti Meteorologiai Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2G.
W86-00021

ANALYSIS OF THE EFFECTS OF OROGRAPHY ON SURFACE RAINFALL BY A PARAMETERIZED NUMERICAL MODEL,

Consiglio Nazionale delle Ricerche, Perugia (Italy). Ist. di Ricerca per la Protezione Idrogeologica nell' Italia Centrale.

C. Corradini.
Journal of Hydrology, Vol. 77, p 19-30, 1985. 3 Fig, 1 Tab, 12 Ref.

Descriptors: *Orography, *Rainfall, *Model studies, *Geography, *Upper Tiber River basin, *Italy, Spatial distribution, Hydrologic models, Data interpretation, Orographic precipitation, Precipitation.

A numerical model was formulated for estimating the spatial distribution of rainfall on the meso-local scale; the model considers widespread rainfall not influenced by convective processes. The observed rainfall on the soil surface unaffected by orographically produced contributions and meteorological parameters on the large scale are used as inputs to the model. The model is then used for computing the spatial distribution of rainfall incorporating the orographic effects in a parameterized form. The model was applied to four rainfall events over an area of the Upper Tiber River basin (central Italy); the results compare reasonably well with the observations in each event. The error in computing mean areal rainfall ranges in magnitude from 1% to 15%; for each event at least 75% of the point-estimates has an error of less than + or - 30%. (Author's abstract)
W86-00023

INTERCEPTION STORAGE CAPACITIES OF TROPICAL RAINFOREST CANOPY TREES,

Boston Coll., Chestnut Hill, MA. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2I.
W86-00037

ESTIMATION OF MISSING VALUES IN MONTHLY RAINFALL SERIES,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
E. Foufoula-Georgiou.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 177-191, 3 Fig, 6 Tab, 19 Ref.

Descriptors: *Statistical analysis, *Time series analysis, *Statistical models, *Model studies, *Mathematical studies, *Stochastic process, *Stochastic hydrology, *Model testing, Statistical methods, Theoretical analysis, Models, Mathematical models.

Three methods for infilling missing values in hydrological time series are discussed. The first method utilizes regional-statistical data by the mean value method, the reciprocal distance method, the normal ratio method or the modified weighted average method. The second method uses a univariate stochastic (ARMA) model which describes the time correlation of the series. The third technique relies on a multivariate stochastic (ARMA) model which describes the time and space correlation of the series. An algorithm for the recursive estimation of the missing values by a parallel updating of the univariate or multivariate stochastic ARMA models is proposed and demonstrated. All of the infilling methods were applied to a case study using 55 yr of monthly rainfall data from four south Florida stations. Results showed that all the the traditional estimation techniques give unbiased (overall and monthly) means and correlation coefficients at the 5% significance level for as high as 20% missing values. If an ARMA model is to be used in an incomplete series to construct forecasts, then the estimation of missing values and parameters of the model by the proposed recursive algorithm is recommended.
W86-00094

AREAL INTENSITY-DURATION-FREQUENCY CURVES: A POSSIBLE WAY OF IMPROVING THE RAINFALL INPUT,

Lund Univ. (Sweden). Dept. of Water Resources Engineering.
J. Niemczynowicz.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 192-201, 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Areal precipitation, *Rainfall intensity, *Graphical methods, *Precipitation intensity, *Depth-area-duration analysis, *Frequency analysis, *Regional analysis, *Mathematical studies, Precipitation, Storms, Rainfall, Runoff, Rain gauges, Urban hydrology, Data interpretation.

Point and areal intensity-duration-frequency (i-d-f) curves for the city of Lund, Sweden were generated using data from a 25 sq km area raingauge network with 12 gauges installed in 1978. The gauges were of the automatic tipping-bucket type and were governed by the same clock to achieve absolute time synchronization. Since the main goal of this study was to compare the point rainfall statistics with the areal rainfall statistics for short term rainfalls, all events with low intensity were taken out of the data base. To extrapolate rainfall data from point to areal values, specific areas were associated to all gauges. Analysis of results showed that areal i-d-f relationships gave different rainfall values then point i-d-f relationships. Areal rainfall intensity values were lower for all durations and return periods. If point i-d-f curves are used for deriving design storms, the error in average rainfall intensity and rainfall volume will be introduced for simulation of runoff from real catchments. The magnitude of error depends on duration, return period, and catchment size. The most significant differences between point and areal rainfall values can be found for short durations and long return periods. The areal i-d-f curves gave more realistic design storms than those derived from point i-d-f curves.
W86-00095

OUTLINE OF SEVERE LOCAL STORMS WITH THE MORPHOLOGY OF ASSOCIATED RADAR ECHOES,

National Weather Service Training Center, Kansas City, MO.
R. Grebe.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-114454. National Oceanic and Atmospheric Administration, Rockville, MD. June 1982. NOAA Technical Memorandum NWS TC 1. 80 p. 56 Fig, 64 Ref, 9 Append.

Descriptors: *Radar, *Storms, *Thunderstorms, *Weather forecasting, *Storm warnings, Storms, Velocity derived fields, Doppler radar.

This outline focuses on the interpretation of conventional radar data for the identification of severe local storms. The technique of improving warnings is dependent upon the ability to identify the potential before the event occurs. The primary tools presently available include trained spotters, and satellite and radar observations. Most of the radar research work in severe local storms accomplished in the 1970's was done with Doppler radar. Doppler is conventional radar plus 'more'. The 'more', velocity derived fields, has increased our understanding of storm structure and the morphology of precipitation related echoes. It will be to the advantage of the operational community using conventional radar to apply the technology of Doppler in a practical way. Documented radar signatures associated with severe local storms dating back to the 1950's have been included. Some of them are in apparent conflict with contemporary storm models. The rationale for including them is (1) these signatures can still be operationally useful as alerting features and (2) today's storm models are likely to change as our understanding of the physical processes that produces them increases. As such, this outline is not intended to conflict with National or Regional Weather Service policy regarding the use of radar signatures in issuing severe thunderstorm or tornado warnings. The test of a radar signature leading to the identification of a severe local storm occurs in the field under the stress of making day-to-day warning decisions. No signature or combination of signatures guarantees the existence of a severe storm any more than a numerical model will produce a perfect weather forecast. In both cases, a probability is assigned to the occurrence of the event and a decision is based on that probability.
W86-00146

MARINE WEATHER OF THE INLAND WATERS OF WESTERN WASHINGTON,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
J. E. Overland, and B. A. Walter.
NOAA Technical Memorandum ERL PMEL-44, January 1983. 62 p, 30 Fig, 7 Tab, 42 Ref.

Descriptors: *Precipitation, *Meteorology, *Climatic data, *Marine climates, *Weather patterns, Washington, Puget Sound, Pacific Ocean, Wind, Olympic Mountains, Topography, Temperature, Hydrology, Hood Canal bridge.

The mid-latitude, west coast marine climate of western Washington is typified in summer by high sea-level pressure as part of the North Pacific weather pattern and in winter by a sequence of storms which originate to the west. Mean and extreme temperatures are moderated by the proximity of the Pacific Ocean and Puget Sound, resulting in a mean temperature of 4 degrees C in January and 17 degrees C in August at Seattle. Local variations in precipitation and wind are influenced by both large-scale weather patterns and the region's topography. Fifty percent of the annual precipitation for most of the inland region falls in the four months from November through February, and less than five percent falls in July and August; the driest region is to the northeast of the Olympic Mountains. Over the inland waters, the winds flow from high to low sea-level pressure in the direction of the local channels. Recent studies by the University of Washington and the Pacific Marine Environmental Laboratory on the Puget Sound convergence zone, sea and valley breeze, precipitation patterns and local wind patterns are summarized. The storm which resulted in destruction of the Hood Canal Bridge has shown that the presence of the Olympic Mountains can induce a regional low-pressure system in their lee which can result in strong surface winds over the inland waters. (Author)
W86-00165

SCPP DATA COLLECTION AND ANALYSIS FOR THE PERIOD 1 SEPTEMBER 1981 THROUGH 31 AUGUST 1962,

Atmospherics, Inc., Fresno, CA..
M. Solak, T. Henderson, R. Allen, S. Barnes, and M. Henderson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116707. Interim Progress Report Number Four, August 27, 1982. 182 p, 62 Fig, 13 Tab, Append. Contract/Grant No. 9-07-85-V0020.

Descriptors: *Precipitation, *Network design, *Cloud physics, *Ice formation, *Weather modification, Sierra Nevada, Orographic precipitation, Data collections, Supercooling, Cooling, Data acquisition, Meteorological data collection, Data processing, Gages, Snow.

Data collection and analysis tasks performed for the Sierra Cooperative Pilot Project are described. The Sierra project is concerned with the physical processes of precipitation formation during the winter over a portion of the Sierra Range in California, artificial enhancement of winter precipitation, and weather resources management to improve California's water resources in this mountain range. Tasks performed were installation, operation, and maintenance of, and data collection and analysis from, a network of precipitation gages as well as ground-based instrumentation for detection of supercooled liquid water.
W86-00216

GROUND-BASE SNOW AND ICE CRYSTAL OBSERVATION SYSTEM USED IN SIERRA NEVADA WINTER OROGRAPHIC STORMS,

Atmospherics, Inc., Fresno, CA..
M. Henderson, M. Henderson, S. Pinion, E. Pinion, and M. Solak.
Technical Report AISCP-841. April 1984. 34 p, 3

Fig, 5 Tab, 38 Photos, 9 Ref. Contract/Grant No. 0-07-85-V0020.

Descriptors: *Precipitation, *Weather modification, *Snow, *Ice, Orographic precipitation, Photography, Cloud physics, Cloud seeding, Artificial precipitation, Sierra Nevada, California, Sierra Cooperative Pilot Project, Sampling, Data acquisition, Crystals.

This report describes the use of a ground based photographic snow and ice crystal observation system during two winter seasons at a fixed sampling site near the summit of the central Sierra Nevada range of California. This research effort was performed as part of the Bureau of Reclamation's Sierra Cooperative Pilot Project (SCCP), an investigation of the technical feasibility and potential economic benefit of cloud seeding in the Sierra Nevada to supplement the region's water supply. Two specific photographic systems and their operational use are detailed. Data reduction and analysis techniques are also described. Conclusions are presented relating to three key topic areas. Those are (1) the suitability of the sampling equipment, sampling strategies and data acquisition/reduction techniques used in the SCPP application, (2) clues to seedability in Sierra storms and (3) the utility of ground-based microphysics measurements in evaluating seeding experiments. (Author)
W86-00222

APPLICATION OF PROBABLE MAXIMUM PRECIPITATION ESTIMATES: UNITED STATES EAST OF THE 105TH MERIDIAN,
National Weather Service, Silver Spring, MD. Office of Hydrology.
E. M. Hansen, L. C. Schreiner, and J. F. Miller.
Available from the Technical Information Service, Springfield, VA 22161 as PB83-118166. NOAA Hydrometeorological Report No. 52, August 1982. 168 p, 57 Fig, 31 Tab, 22 Ref, 1 Append.

Descriptors: *Precipitation, *Rainfall, Rainstorms, Maximum probable precipitation, Meteorology, Storms, Isohyets, Temporal distribution, Spatial distribution, Distribution, Estimating.

A stepwise approach to adapting the temporal and spatial distribution of probable maximum precipitation estimates to a specific drainage is given. An elliptical isohyetal pattern with a ratio of major to minor axes of 2.5 to 1 is recommended. Procedures are outlined for obtaining appropriate isohyet values and for determining probable maximum precipitation values for durations less than 6 hours. The shape and orientation of isohyetal patterns for major rainfalls of record are included. An appendix lists storm duration, storm area, and 24-hour rainfall for 253 major storms from 1878 to 1972.
W86-00229

BOULDER UPSLOPE CLOUD OBSERVATION EXPERIMENT.
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116673. June 1982. Earl E. Gossard, editor. 237 p, 34 Fig, 14 Tab, 2 Ref, 2 Append.

Descriptors: *Precipitation, *Cloud physics, *Remote sensing, *Meteorologic data collection, Upslope precipitation, Ice, Snow, Fog, Radar, Radiometers, Lidar, Aircraft, Ceilometer, Boulder Upslope Cloud Observation Experiment, Data collections, Crystals, Microwaves, Weather.

The Boulder Upslope Cloud Observation Experiment was designed to learn more about the role of ice crystals in the formation of clouds and precipitation under upslope conditions; to calibrate the remote sensing systems against reliable in situ devices in a steady, homogeneous cloud environment; and to evaluate the systems' applicability for observing the role of ice crystals and cloud microphysics in the evolution of upslope precipitation. Eleven principal weather events in the spring of 1982 are described. In situ measurements were made by aircraft, tower particle measurements, surface chemistry sampling, all-sky camera, and rotating beam ceilometer. Ground-based remote sensing measurements were made by radiometer, radar, and lidar.
W86-00261

POSTSTORM RECONNAISSANCE OF TROPICAL STORM CHRIS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
T. H. Flor.
Miscellaneous Paper HL-83-5, July 1983. Final Report. 18 p, 9 Fig, 6 Append.

Descriptors: *Precipitation, *Storms, Tropical Storm Chris, *Flood damage, Tidal floods, Shores, Seashores, Damage, Rainstorms.

Tropical Storm Chris made landfall in Louisiana, 7 miles east of Sabine Pass, Texas, at 0600 CDT on September 11, 1982. Highest sustained winds were 55 knots. Lowest pressure was estimated to be 994 mbs. Highest tides were between 5 and 6 feet just east of the center. Rainfall was 5 to 10 inches in Louisiana, with a few local amounts greater than 10 inches. The highest storm-generated surge, 8.5-9 ft, occurred at Peveto Beach, 8 miles east of the point of landfall. Flooding west and east of the point of landfall was 2.8 ft above predicted tide level 17 miles to the west and 2.5 ft above predicted tide 19 miles to the east. No casualties were reported. Damage estimates were < $1 million in Louisiana. Power lines, trees, and boats were also damaged, as well as a restaurant in Texas.
W86-00279

CLOUD PHYSICS STUDIES IN THE SCPP: INTERIM PROGRESS REPORT, 1983-84.
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W86-00305

STRUCTURE OF COLD FRONTS OVER CALIFORNIA,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W86-00306

RESPONSES TO SEEDING CLOUDS WITH DRY ICE IN THE SCPP-1 EXPERIMENT,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W86-00307

2C. Snow, Ice, and Frost

RUNOFF FROM GLACIERIZED MOUNTAINS: A MODEL FOR ANNUAL VARIATION AND ITS FORECASTING,
Stirling Univ. (Scotland). Dept. of Environmental Science.
For primary bibliographic entry see Field 2E.
W86-00077

SNOWMELT INDUCED URBAN RUNOFF IN NORTHERN SWEDEN,
McMaster Univ., Hamilton (Ontario).
L. Bengtsson.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 215-236, 6 Fig, 11 Tab, 10 Ref.

Descriptors: *Snowmelt, *Runoff, *Snowpack, *Design criteria, *Melting, *Urban runoff, *Surface runoff, *Overland flow, Annual runoff, Soil water, Infiltration rate, Infiltration capacity, Snow cover, Thaw, Urban hydrology.

Snowmelt and runoff data collected at different sites in the Lule region of Sweden over a 7 yr period are summarized and analyzed. The maximum observed melt flux to the base of a snowpack during 1 h is 4.1 mm/h. The maximum observed daily melt is 40 mm, but the daily melt of a 2-yr return period is only 20 mm. The runoff from small study plots, at least in practical considerations, is found to be distributed over about 12 h. The maximum observed runoff from these study plots of hard packed gravel or grass surfaces is about 2 mm/h. In the late phase of a snowmelt period, the daily runoff closely corresponds to the daily melt. However, the very maximum runoff values are observed during or some days after the snowmelt period. Overland flow or flow just below the ground surface takes place. Design melt rates for open areas in Sweden are 20 mm/12 h for a melt rate of 1-yr return period and 3 mm/h for a shorter interval. For urban areas a value of at least 30 mm/12 h is suggested. For forested areas the value should be 10 mm/12 h. Rain during the snowmelt should be added to the melt. If there is much rain in the autumn and soil temperatures are low before snow cover is formed, overland flow should take place from all surfaces in the late snowmelt period. If the soil is packed hard, the runoff may correspond to the melt rate.
W86-00097

2D. Evaporation and Transpiration

COMPARING THE PERFORMANCE OF ROOT-WATER-UPTAKE MODELS,
Katholieke Univ. Leuven (Belgium). Lab. of Soil Physics.
M. Alaerts, M. Badji, and J. Feyen.
Soil Science, Vol. 139, No. 4, p 289-296, April, 1985. 6 Fig, 2 Tab, 8 Ref.

Descriptors: *Root-water-uptake models, *Soil water, *Model studies, Sink terms, Root-water-extraction terms, Hydrologic budget, Nitrogen budget, Transpiration, Nutrient removal, Nutrient uptake.

To model the water balance of a cropped soil, a root-water-extraction term, the so-called sink term, is added to the general flow equation describing the water flow in the unsaturated zone. To compare different proposed sink-terms, they should be used as variable components of the same field water budget model. Four root-water-extraction terms selected from the literature were adapted and inserted into the field water budget model SWATRE. The models were run with simplified initial and boundary conditions and showed agreement with regard to the cumulative water loss over a period of 20 d, if the input data and parameter values were adjusted. They resulted, however, in significantly different daily water-extraction-depth patterns. The most sophisticated model appears to contain a number of redundant terms, and the least complicated model could not be applied when a water table was present. The water-extraction-depth pattern is of special importance if the water budget model is used as a component of, for example, a nitrogen budget model. The simulated nutrient uptake will depend greatly on the moisture extraction pattern. Choice of sink term might be difficult under real field conditions and with validation data available. All sink terms require the choice of parameters adapted to the particular soil-plant combination. This almost automatically implies some data-fitting, because independent data for similar conditions are rarely available, and the knowledge for extrapolating from different conditions is lacking. Too little seems to be known about plant transpiration and water extraction patterns to result in a general extraction term which is simple and economical to use and satisfying in concept and results. (Collier-IVI)
W86-00048

2E. Streamflow and Runoff

NUMERICAL MODELLING OF SUBCRITICAL OPEN CHANNEL FLOW USING THE K-EPSILON TURBULENCE MODEL AND THE PENALTY FUNCTION FINITE ELEMENT TECHNIQUE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
A. N. Puri, and C. Y. Kuo.

Applied Mathematical Modelling, Vol. 9, No. 2, p 82-88, April, 1985. 8 Fig, 1 Tab, 21 Ref.

Descriptors: *Mathematical models, *Open-channel flow, *Turbulent flow, *Penalty function, *Finite element method, Curved channels, Flow, Channel flow, Momentum dispersion models, Turbulence closure models.

A numerical model has been developed that employs the penalty function finite element technique to solve the vertically averaged hydrodynamic and turbulence model equations for a water body using isoparametric elements. Solving of the full elliptic forms of the equations allowed recirculating flows to be calculated. Alternative momentum dispersion and turbulence closure models were evaluated by comparing model predictions with experimental data for strongly curved subcritical open channel flow. The results of these simulations indicate that the depth-averaged two-equation K-epsilon turbulence model yields excellent agreement with experimental observations. Neither the streamline curvature modification of the depth-averaged K-epsilon model, nor the momentum dispersion models based on the assumption of helicoidal flow in a curved channel, yield significant improvement in the present model predictions. Overall model predictions were found to be as good as those of a more complex and restricted three-dimensional model. (Author's abstract)
W86-00003

SPATIALLY VARYING RAINFALL AND FLOODRISK ANALYSIS,

Massachusetts Inst. of Tech., Cambridge.
R. L. Bras, D. R. Gaboury, D. S. Grossman, and G. J. Vicens.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 754-773, May, 1985. 10 Fig, 5 Tab, 7 Ref.

Descriptors: *Rainfall distribution, *Floodrisk analysis, *Flood forecasting, *Cumberland River Basin, *Kentucky, *Tennessee, *Simulation analysis, Model studies, Rainfall-runoff relationships, Discharge frequency.

A mathematical simulation model of the spatial and temporal rainfall process was developed and used to input to distributed rainfall-runoff models in order to obtain streamflow series at multiple locations in large river basins. Frequency analysis under different basin development and control alternatives can then be performed. A location in the Cumberland River Basin (Kentucky and Tennessee) was studied. The basin is 46,397 sq km (17,914 sq mile) and thus exhibits large rainfall variability in space. The rainfall model was calibrated with 28 yr of hourly and daily rainfall data in 274 stations in and around the basin. By using generated rainfall as input to a previously calibrated distributed rainfall-runoff model, discharge frequency curves were obtained at 14 locations. The curves corresponded to both the system with eight operational flood control reservoirs and the natural system without regulation. (Author's abstract)
W86-00012

METHOD OF PREDICTING DAILY PEAK FLOWS IN THE HIGH-FLOW SEASON,

Saskatchewan Univ., Saskatoon. Dept. of Geography.
P. R. Waylen.
Journal of Hydrology, Vol. 77, p 89-105, 1985. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Peak flows, *Flood forecasting, *Seasonal distribution, *British Columbia, Streamflow forecasting, Forecasting, Orographic precipitation, Data interpretation, Statistical analysis, Model studies.

Partial duration series provide a method of obtaining the distributions of both high-flow variables and annual floods. The seasonal nature of streamflow requires assumptions of nonhomogeneity of the timing of events. The modeling of timing is based upon the temporal behavior of high flows generated by distinct processes. The approach is physically meaningful and able to accommodate several generating processes. In southern British Columbia, Canada, snowmelt and rainfall produce high flows. Individually the distribution of each set of annual maxima produced by the respective processes are successfully represented by a double exponential distribution which, compounded, provide a good fit in locations of mixed generating processes. In all cases introduction of the time nonhomogeneity term to the double exponential for periods of less than 1 yr. provides a good fit to the observed distribution of daily peak flows throughout the high-flow season. (Author's abstract)
W86-00027

DISCRETE-TIME LINEAR CASCADE UNDER TIME AVERAGING,

National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2A.
W86-00028

GOULD'S PROBABILITY MATRIX METHOD; 1. THE STARTING MONTH PROBLEM,

Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol. 77, p 125-133, 1985. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Streamflow, *Gould's probability matrix, Australia, Rivers, Reservoirs, Probability distribution.

A major problem of water-supply authorities is to determine the relationship of the capacity of a large reservoir with its inflows and potential releases. Annual and/or monthly streamflow data for nine Australian rivers covering a range of characteristics are used to aid in solving this problem. Mean monthly flows (expressed as percentages of annual flow) and the annual coefficients of variation and lag-1 autocorrelation coefficients for different starting months are shown. Results based on synthetic data indicate that in Gould's probability matrix method the yearly routing of monthly flows should start in a month of low mean monthly flow. Results from historical data also indicated this, but are masked by the sample variability of the estimates. For analysis, the monthly data should be assembled into years defined by the water year which should begin and end normally during a time of low flow. (Baker-IVI)
W86-00029

GOULD'S PROBABILITY MATRIX METHOD; 2. THE ANNUAL AUTOCORRELATION PROBLEM,

Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol. 77, p 135-139, 1985. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Gould's probability matrix, *Streamflow, *Autocorrelation, Reservoirs, Water supply, Water storage, Flow.

The effect of lag-1 annual autocorrelation on storage sizes obtained from Gould's probability matrix method is examined using long sequences of generated data. The range of applicability of Gould's method and the associated correction factors for annual autocorrelation are proposed. The correction factor to take into account the annual autocorrelation coefficient was found to depend mainly on the annual lag-1 autocorrelation coefficient, r, and storage size. Except for a few limited combinations of r, annual coefficients of variation (Cv), and draft, the correlation factor is larger than 1.5, implying Gould's transition probability matrix method is not a suitable procedure for rivers with significant annual autocorrelation coefficients. Gould's procedure may be used for small r (0.2) so long as the correction factor is not greater than 1.5. Correction factors are presented. (Baker-IVI)
W86-00030

VARIANCE OF THE T-YEAR EVENT IN THE LOG PEARSON TYPE-3 DISTRIBUTION,

Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and L.-C. Hsu.
Journal of Hydrology, Vol. 77, p 141-158, 1985. 6 Tab, 11 Ref.

Descriptors: *Floods, *Rainfall, *Distribution, *Log Pearson type-3 distribution, Mathematical equations, Variance, Computers.

Detailed schemes for computing the variance of the T-yr. event, the variances and covariances of the parameter estimates for the LP3 distribution were described along with the provision of analytical formulae for all related computations. Variances and covariances are analytically derived in this study for the case where the parameters are estimated by the methods of direct and mixed moments. The examples given clearly show that the error committed in estimating the parameters of the LP3 distribution was very high, and the highest error seemed to take place in estimating the shape parameter. At present, an attempt is being made to apply the presented computational schemes to many more data sets of annual floods and annual maximum rainfalls, whereby general conclusions may be drawn on the performance of the different methods for parameter estimation. To help the evaluation process, a set of computer programs in FORTRAN have been developed according to the schemes presented in this paper. (Baker-IVI)
W86-00031

COMPARISON OF TWO DAILY STREAMFLOW SIMULATION MODELS OF AN ALPINE WATERSHED,

Colorado Univ. at Boulder. Dept. of Civil, Environmental, and Architectural Engineering.
C. M. Brendecke, D. R. Laiho, and D. C. Holden.
Journal of Hydrology, Vol. 77, p 171-186, 1985. 6 Fig, 2 Tab, 20 Ref.

Descriptors: *Alpine areas, *Streamflow, *Simulation, *Model studies, *Colorado, Computer models, Data interpretation, Hydrograph, Rainfall-runoff relationships, Hydrologic models.

A comparison of daily streamflow simulation by two different computer models has been completed for an alpine basin in central Colorado, U.S.A. The catchment is part of a 33-sq km area providing most of the City of Boulder's raw water supply. It is located between 2964 and 4103 m a.s.l. in elevation along the Continental Divide 24 km west of Boulder, Colorado. The Streamflow Synthesis and Reservoir Regulation model, which makes generous use of lumped-type parameters, was compared with the Precipitation Runoff Modeling System (PRMS) model, which makes greater use of individually defined parameters, by examining their respective ability to fit observed hydrograph volumes and shape. Both computer models were found to simulate streamflow equally well. The PRMS model was found to be more suitable overall because of its ability to handle small catchments and the generous use of individual physically-based parameters. (Author's abstract)
W86-00033

DETERMINATION OF RESISTANCE PARAMETERS OF PLUVIO-NIVO-GLACIAL ALPINE SYSTEMS BY MATHEMATICAL MODELING OF RUNOFF,

Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
A. A. Van De Griend, and E. Seyhan.
Journal of Hydrology, Vol. 77, p 187-207, 1985. 7 Fig, 1 Tab, 42 Ref.

Descriptors: *Alpine regions, *Mathematical models, *Runoff, *Hydrologic models, *Italy, Rainfall-runoff relationships, Glaciohydrology, Snowmelt, Geohydrology.

A nonlinear optimization technique has been applied to analyze complex hydrographs from an alpine catchment with pluvial, nival and glacial regime components, in order to determine bulk resistance parameters of the contributing systems. Both the fluvial system and the nivo-glacial system

are represented by a linear system function. Application of the optimization model to monthly time series of daily runoff, revealed the time variability of the systems operation which reflects the seasonal variability of hydro(geo)logical and snow-hydrological conditions relevant for the creation of runoff. The model has been applied to a northern Italian Alpine catchment with a runoff record of 22 yr. (Author's abstract)
W86-00034

MULTIPLE NONLINEAR STATISTICAL MODELS FOR RUNOFF SIMULATION AND PREDICTION,

Alcoa of Australia Ltd., Applecross.
E. N. Tsykin.
Journal of Hydrology, Vol. 77, p 209-226, 1985. 1 Fig, 3 Tab, 9 Ref, 3 Append.

Descriptors: *Statistical models, *Runoff, *Prediction, Model studies, Rainfall-runoff relationships, Hydrologic models, Soil water.

The lack of accuracy of statistical rainfall-runoff models is often caused by lack of correspondence between the nonlinear structure of the process and the linear structure of the statistical equation. Multiple nonlinear equations with separate antecedent soil-moisture indices for each time period and with a combined intercept allow the modeling of rainfall-runoff relations with high accuracy. The coefficients of determination between actual and simulated runoff for the calibration periods are typically higher than 0.90 and often as high as 0.96. Extrapolation over periods 3-4 times longer than the calibration have provided accurate predictions, with corresponding R2-values of 0.85 and higher. Extrapolations using these models are accurate even when the calibration period is relatively short and its range is smaller than the range of the predicted values. (Collier-IVI)
W86-00035

ESTIMATES OF PEAK RUNOFF FROM HILLY TERRAIN WITH VARIED LITHOLOGY,

International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
A. M. J. Meijerink.
Journal of Hydrology, Vol. 77, p 227-236, 1985. 6 Fig, 9 Ref.

Descriptors: *Peak runoff, *Runoff, *Topography, *Lithology, *Italy, *Spain, *India, *Tunisia, *Carinena, Slope-area method, Geomorphology, Streamflow, Rainfall distribution, Soil conservation.

Rainfall data for shorter durations may not be adequate in areas with strong relief; in such cases the common engineering formulas for the estimations of the peak discharges are difficult to apply. It may also not be feasible to use empirical formulas based on regression analyses from nearby regions. For estimating the peak flows one may have to resort to the use of the slope-area method and survey channel sections. Estimates of peak runoff were made using the slope-area method in hilly regions with poor adjustment of channel morphology to high flows. Geomorphological maps were made for each of four areas studied. The main units coincided with the geology and within each of the main units, channel reaches were surveyed. Small rivers were investigated in four areas: A basilicata area in southern Italy; the area around Carinena in central Spain; the area around Bata Nala-Renuka, Himachal Pradesh in north India; and the area around Kasserine in southwestern Tunisia. Despite the inaccurate nature of the methods, a meaningful interpretation of the results could be made. In the two Mediterranean areas the effects of the highly differing morpholithological units on the peak runoff could be demonstrated, although estimates of few catchments have been used. The method is not sensitive enough to reflect the effects of less pronounced morphologic variations and supposed geographic variations in rainfall intensities; this is indicated by the results of the area in northern India. In the semi-arid area of Kasserine the lithology and geomorphology did not seem to affect the peak flows with great return periods. The method may contribute to improved methods in soil and water conservation, and estimates of the capacities of cross-drainage works. An idea of the internal variation of direct response within larger catchments can also be obtained. (Collier-IVI)
W86-00036

CONDENSED DISAGGREGATION MODEL FOR INCORPORATING PARAMETER UNCERTAINTY INTO MOUTHLY RESERVOIR SIMULATIONS,

Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. R. Stedinger, D. Pei, and T. A. Cohn.
Water Resources Research, Vol. 21, No. 5, p 665-675, May, 1985. 7 Fig, 5 Tab, 74 Ref. NSF grant CME 8010889.

Descriptors: *Reservoirs, *Simulation, *Boise River, *Rappahannock River, Model studies, Parameters, Distribution, Water supply, Water shortages, Reservoir failure.

A condensed version of the Valencia-Schaake disaggregation model was developed which describes the distribution of monthly streamflow sequences using a set of coupled univariate regression models rather than a multivariate time series formulation. The model is attractive because it has fewer parameters but can still reproduce the means, variances, and period to period correlations of the individual flows while approximately preserving the relationship among the monthly and annual flow values. The simple autoregressive form of the condensed disaggregation model facilitates the use of Bayesian inference theory to describe uncertainty as to the most appropriate values of the model's parameters. This allows construction of a two stage streamflow generation procedure which captures both the uncertainty as to what the model's parameters might be and the characteristics of flow sequences a model with those parameters might generate. The differences in estimates of reservoir system performance statistics due to the choice of different but reasonable models are generally relatively modest. The limited information available to estimate the parameters of the chosen model can have a striking and serious impact on the ability to specify how a given reservoir system is likely to perform in the future. Modeled sequences describe flows in the Rappahannock River in Virginia and the Boise River in Idaho. For high-reliability systems the results show that streamflow generation procedures which ignore model parameter uncertainty can grossly underestimate reservoir system failure rates and the severity of likely shortages, even if based on a 50-year record. (Baker-IVI)
W86-00073

INTERANNUAL STEAMFLOW VARIABILITY IN THE UNITED STATES BASED ON PRINCIPAL COMPONENTS,

Geological Survey, Reston, VA.
H. F. Lins.
Water Resources Research, Vol. 21, No.5, p 691-701, May, 1985. 8 Fig, 3 Tab, 20 Ref.

Descriptors: *Streamflow, *Variability, *Principal component analysis, Time series analysis, Flow, Autocorrelation.

Interannual modes of streamflow variation at 106 locations across the United States during the period 1931-1978 are defined by using principal components. Nearly 60% of the total variance could be explained by five principal components. Each component describes a spatially distinct mode of variation in terms of the departure of flows from period-of-record mean conditions. Thus the first principal component represents a uniform nationwide function; the second, a north-south opposition in flow departures; the third, an east-west opposition; the fourth, a coastal-continental opposition; and the fifth, a northern plains-southern plains opposition. Each successive principal component describes an increasingly more regional pattern of streamflow variation. These component patterns, especially the first three, exhibit considerable spatial stability based on similar analyses using altered data sets. Temporally, component stability is less certain, except in the case of the first component. Time series analysis of component scores indicates that most component functions are best described as AR(1) processes. Component four, the coastal-continental flow opposition function, appears to be an AR(2) process. Given the characteristics of principal components to describe the most organized modes of variation in a data set, it is not surprising that four of the first five components have stronger autocorrelation functions at low lags than does mean annual streamflow. Principal components can be used to identify the primary modes of variability in large multivariate fields of streamflow data. The principal components of streamflow exhibit more persistence than mean annual streamflow. For certain applications involving the analysis of large spatial and long temporal sets of flow data, parsimony without significant compromise in information may be achieved using principal components. (Baker-IVI)
W86-00076

RUNOFF FROM GLACIERIZED MOUNTAINS: A MODEL FOR ANNUAL VARIATION AND ITS FORECASTING,

Stirling Univ. (Scotland). Dept. of Environmental Science.
R. I. Ferguson.
Water Resources Research, Vol. 21, No. 5, p 702-708, May. 1985. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Snowmelt, *Runoff, *Glaciers, *Mountains, *Streamflow, Snow, Ice, Forecasting, Satellite technology, Snowcover, Snow accumulation, Remote sensing, Orographic variation.

For remote high mountain basins, such as the upper Indus in Pakistan, the only means of forecasting spring and summer runoff is from preseason snow cover on satellite images. Previous studies have shown that regression coefficients of runoff on snow cover differ between basins in magnitude and sign. A simple formal analysis of annual meltwater yield from high mountain basins explains why its relationship with preceding snow cover varies from basin to basin in sign and sensitivity and identifies a number of additional glacioclimatic parameters that are relevant but cannot be determined from preseason satellite imagery. A simple but flexible parameterization of orographic variation in snow accumulation and potential snowmelt enables prediction of annual meltwater runoff from the extent of winter snow cover, with bounds attached to allow for variation in summer heat input to glacier ablation zones. The moderating influence of glaciers on runoff gives way in highly glacierized basins to an inverse relationship between annual meltwater runoff and preceding snow cover. The critical glacier extent may be a slow as 10-20% where there is a strong orographic increase in snow accumulation. The value of satellite imagery for forecasting meltwater yield from high mountains would be improved by using late summer images to estimate glacierized areas, firn zone extent, and a latter's year to year variation. Even so there is still a need for ground investigation of the spatial, especially orographic, variation in snow accumulation and potential snowmelt. (Baker-IVI)
W86-00077

MINIMUM VARIANCE STREAMFLOW RECORD AUGMENTATION PROCEDURES,

Tufts Univ., Medford, MA. Dept. of Civil Engineering.
R. M. Vogel, and J. R. Stedinger.
Water Resources Research, Vol. 21, No. 5, p 715-723, May, 1985. 7 Fig, 4 Tab, 25 Ref.

Descriptors: *Floods, *Streamflow, *Variance, Estimating, Flood peaks, Sampling, Matalas-Jacobs estimators.

Augmentation procedures have been recognized as a useful approach for estimating the mean and variance of short hydrologic records. Approaches for augmentation of short-streamflow records have exploited the cross-correlation among flows at two or more gages to obtain maximum likelihood estimates of the mean and variance of the flows at the

short-record gage. Estimators of the mean and variance of the flows at a short record site were derived which should have lower variance than the unbiased maximum likelihood or Matalas-Jacobs estimators for the small samples of interest in hydrology. Since the Matalas-Jacobs estimators as well as the estimators introduced in this study require an estimate of the flow's cross correlation p, a Monte-Carlo experiment was performed to evaluate the impact of using the sample cross-correlation on their root mean square error (rmse). In general, these estimators have essentially an equal or, as is more often the case, a lower rmse than the Matalas-Jacobs estimators. The sampling properties of estimators of the mean and variance of the flows at the short record site were examined. The potential advantages and limitations of these new estimators are discussed within the framework of augmentation and/or extension of both peak annual floods and also monthly streamflow records. (Baker-IVI)
W86-00079

UNIT HYDROGRAPH APPROXIMATIONS ASSUMING LINEAR FLOW THROUGH TOPOLOGICALLY RANDOM CHANNEL NETWORKS,

Geological Survey, Lakewood, CO. Water Resources Div.
B. M. Troutman, and M. R. Karlinger.
Water Resources Research, Vol. 21, No. 5, p 743-754, May, 1985. 4 Fig, 27 Ref, 1 Append.

Descriptors: *Runoff, *Drainage basins, *Flow, *Unit hydrographs, Mathematical equations, Laplace equation, Precipitation, Drainage, Surface flow.

One of the important processes in defining runoff response of a drainage basin, movement of water on the surface through a channel network, is considered. Infiltration, subsurface flow, and overland flow are not considered. The instantaneous unit hydrograph (IUH) of a drainage basin is expressed as a function of (alpha, beta, N), of (alpha, beta, N, D) and of (alpha, beta, N, M). The parameter alpha characterizes the link (channel segment) lengths, beta is a hydraulic parameter, N is number of first-order streams, D is diameter (mainstream length), and M is order. Obtaining the IUH may involve numerical solution of the difference equation or numerical inversion of a Laplace transform. Both of these tasks, however, are readily performed on a digital computer. The IUH is derived based on assumptions that the links are independent and identically distributed random variables and that the network is a member of a topologically random population. Linear routing schemes, including translation, diffusion, and general linear routing are used, and constant drainage density is assumed. By using (N, alpha, beta) as the fundamental basin characteristics, asymptotic (for large N) considerations lead to a Weibull probability density function for the IUH. This asymptotic IUH is identical for all linear routing schemes. (Baker-IVI)
W86-00082

PROBABILISTIC STRUCTURE OF STORM SURFACE RUNOFF,

Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. R. Cordova, and I. Rodriguez-Iturbe.
Water Resources Research, Vol. 21, No. 5, p 755-763, May, 1985. 7 Fig, 5 Tab, 8 Ref, 1 Append. Venezuela National Research Council grant S1-1212.

Descriptors: *Rainfall intensity, *Storm runoff, *Rainfall-runoff relationships, Probability, Storms, Infiltration, Mathematical equations.

The mean and variance of storm surface runoff are derived under the assumption that storm events are rectangular pulses with a bivariate exponential distribution for the intensity and duration of the storm. The Philip infiltration equation is used to make the transformation between rainfall and surface runoff. The probability of zero storm surface runoff mean and variance of storm surface runoff is also calculated under the same assumptions. The correlation between intensity and duration of the storm has an important impact on the probabilistic structure of storm surface runoff. The correlation between intensity and duration of the storm has an important impact on the probabilistic structure of storm surfce runoff. Equations are given which take into account such a correlation and provide the hydrologist with a way to estimate the mean and variance of storm surface runoff. It is not advisable to assume beforehand that intensity and duration are uncorrelated random variables, and an effort should be made to estimate the correlation between these climatic characteristics. The correlation between intensity and duration increases the probability of occurrence of storm surface runoff, which shows a significant increase for soil moisture contents above 60%. (Baker-IVI)
W86-00083

HYDROLOGICAL REGIONALISATION: A QUESTION OF PROBLEM AND SCALE,

Vrije Univ., Amsterdam (Netherlands).
I. Simmers, and E. Seyhan.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of FLorida, Gainesville. p 202-214, 6 Fig, 3 Tab, 20 Ref.

Descriptors: *Streamflow, *Runoff, *Hydrologic models, *Catchment areas, *Regional analysis, *Hydrologic data collection, *Surface runoff, Data collections, Model studies, Watersheds, Land use, Spatial distribution, Models, Topography.

Parameter prediction for ungauged catchment areas and regionalization of hydrological data depend on two fundamental issues - the problem to be resolved and the scale at which a solution is required. A simplified, dynamic method for regionalization of hydrological data is presented which encompasses these issues and is currently being applied to an ongoing study in east Luxembourg. Since the problem to be resolved in two catchments (the Tollbach and the Dosbach) involves prediction of hydrological response consequent upon land use change, the scale is small and requires the consideration of the dynamic spatial variation in discharge source areas. Data collection was initiated from a regionalized sampling matrix technique according to topography, vegetative cover, and nature of surficial deposits. The watershed is thus regarded as a system which consists of a series of homogenous units each contributing to runoff formation and streamflow generation. The described approach to regionalization is considered robust and, if combined with remote sensing, should minimize instrumental and data collection requirements.
W86-00096

ADVANCEMENT IN HYDRAULIC MODELING OF POROUS PAVEMENT FACILITIES,

Espey, Huston and Associates, Inc., Austin, TX.
G. F. Goforth.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January, 27-28, 1983, University of Florida, Gainesville. p 237-254, 8 Fig, 3 Tab, 5 Ref.

Descriptors: *Urban runoff, *Porous pavement, *Surface runoff, *Storm runoff, *Simulation analysis, *Drainage engineering, *Porous media, *Paving, *Hydraulic models, Runoff, Models, Model studies, Urban hydrology, Hydrologic budget, Storm seepage, Asphalt.

A porous pavement facility is an innovative solution to the problems of stormwater drainage from parking and other low density traffic areas in urban landscapes. Stormwater hydraulic characteristics of porous and nonporous pavement sites were evaluated using a revised version of the computer model PORPAV. PORPAV is a two-dimensional dynamic water budget analysis of a pavement facility which was initially developed for use in the EPA Storm Water Management Model. The utilization of PORPAV allows a comprehensive analysis of flow and storage in pavement facilities to aid in comparisons of the hydraulic response of alternative pavement designs. Monitoring surveys and stormwater simulations using PORPAV were carried out on three parking lots made of porous asphalt, gravel trench material, and conventional asphalt, respectively. Results showed that PORPAV satisfactorily simulated sprinkler-generated stormwater hydraulics of both porous and nonporous pavement facilities. Sprinkler application rates ranged from 0.4 to 1.7 inches/hr. Observed runoff ranged from 37 to 73% of recorded sprinkler inflow for the porous asphalt lot, 64 to 73% of recorded sprinkler inflow for the gravel trench lot and 71 to 118 volume % of recorded rainfall for the conventional asphalt lot.
W86-00098

TIME-OF-TRAVEL DATA FOR NEBRASKA STREAMS, 1968 TO 1977,

Geological Survey, Lincoln, NE. Water Resources Div.
L. R. Petri.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-602, 1984. 63 p, 17 Fig, 20 Tab, 6 Ref.

Descriptors: *Dye-tracing, *Time-of-travel measurements, *Surface-water discharge, *Nebraska, Streams.

This report documents the results of 10 time-of-travel studies, using 'dye-tracer' methods, conducted on five streams in Nebraska during the period 1968 to 1977. Streams involved in the studies were the North Platte, North Loup, Elkhorn, and Big Blue Rivers and Salt Creek. Rhodamine WT dye in a 20 percent solution was used as the tracer for all 10 time-of-travel studies. Water samples were collected at several points below each injection site. Concentrations of dye in the samples were measured by determining fluorescence of the sample and comparing that value to fluorescence-concentration curves. Stream discharges were measured before and during each study. Results of each time-by-travel study are shown on two tables and on graph. The first table shows water discharge at injection and sampling sites, distance between sites, and time and rate of travel of the dye between sites. The second table provides descriptions of study sites, amounts of dye injected in the streams, actual sampling times, and actual concentrations of dye detected. The graphs for each time-of-travel study provide indications of changing travel rates between sampling sites, information on length of dye clouds, and times for dye passage past given points. (USGS)
W86-00120

STREAMFLOW LOSSES ALONG THE BALCONES FAULT ZONE, NUECES RIVER BASIN, TEXAS,

Geological Survey, Austin, TX. Water Resources Div.
L. F. Land, C. W. Boning, L. Harmsen, and R. D. Reeves.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 83-4168, 1983. 72 p, 36 Fig, 11 Tab, 4 Ref.

Descriptors: *Base flow, *Discharge measurement, Recharge, *Texas, *Streamflow losses, *Streamflow gains, Nueces River basin, Edwards aquifer.

An investigation was conducted to quantify and to determine distribution of streamflow losses and gains that occur during base flow conditions in the Balcones Fault Zone of the Neuces River basin. The streams studied include the West Nueces, Nueces, Dry Frio, Frio, and Sabinal Rivers, and Seco, Hondo, and Verde Creeks. Discharge measurements made during storm recession flows of these streams identified direct recharge to outcrops of the Edwards aquifer and related limestones that ranged from as high as 393 cubic feet per second for the Frio River to as low as 42 cubic feet per second for the Sabinal River. Recharge to outcrops of the Buda Limestone, Eagle Ford Shale, and Austin Group also eventually reaches the Edwards aquifer, and measurements identified losses to these formations ranging from as high as 174 cubic feet per second for the Frio River to near zero for Verde Creek. (USGS)

W86-00124

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1981 VOLUME 1: NORTHEAST FLORIDA.

Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00127

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1982, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00128

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00129

WATER RESOURCES DATA HAWAII, OTHER PACIFIC AREAS, WATER YEAR 1981. VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRONESIA, PALAU ISLANDS AND AMERICAN SAMOA.

Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00130

ATCHAFALAYA RIVER DELTA; REPORT 9: WIND CLIMATOLOGY,

Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 2L.
W86-00163

ATCHAFALAYA RIVER DELTA; REPORT 8: NUMERICAL MODELING OF HURRICANE-INDUCED STORM SURGE,

Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 2A.
W86-00164

PRELIMINARY USER'S MANUAL 3-D MATHEMATICAL MODEL OF COASTAL, ESTUARINE, AND LAKE CURRENTS (CELC3D),

Aeronautical Research Associates of Princeton, Inc., NJ.
Y. P. Sheng.
Instruction Report D-84-1, April 1984. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 52 p, 10 Fig, 3 Tab, 11 Ref, 2 Append.

Descriptors: *Finite difference methods, *Mathematical models, *Water currents, *Fluid mechanics, *Computer models, Models, Model studies, Hydrologic models, Simulation analysis, Estuaries, Lakes, Differential equations, Mathematical studies, Coastal waters.

An efficient and comprehensive three-dimensional finite-difference model of coastal, estuarine, and lake currents (CELC3D) has been developed and is currently operative on a VAX-11/780 minicomputer. This user's manual discusses the special model features, general structure of the CELC3D computer code, sub-program summary, input/output data, and data requirements, and gives an example calculation by simulating the tide- and wind-driven currents in the Mississippi coastal water of the Gulf of Mexico. The CELC3D code can be used for the computation of two- or three-dimensional unsteady currents in coastal, estuarine, or lake waters based on the free-surface model described in detail by Sheng (1983). The present version of the code contains no buffering scheme and is programmed to run entirely in the central memory. The CELC3D program solves the mean equations of fluid motion within a water body with respect to a right-handed Cartesian coordinate system located at the nominal water surface. These equations consist of the partial differential equations for surface displacement, vertically integrated velocities, three-dimensional velocities, temperature, salinity, density, and sediment concentration.
W86-00168

CURRENT MEASUREMENTS IN THE COLUMBIA RIVER ESTUARY,

Chalmers Univ. of Technology, Goeteborg (Sweden). Institutionen foer Kaernkemi.
For primary bibliographic entry see Field 2L.
W86-00181

DEVELOPMENT OF A NUMERICAL MODELING CAPABILITY FOR THE COMPUTATION OF UNSTEADY FLOW ON THE OHIO RIVER AND ITS MAJOR TRIBUTARIES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. H. Johnson.
Technical Report HL-82-20, August 1982. Final Report. 154 p, 83 Fig, 7 Tab, 8 Ref, 3 Append.

Descriptors: *Rivers, *Flow characteristics, *Navigation, *Locks, *Dams, Model studies, Mathematical models, Unsteady flow, Ohio River, Reservoir operation, Tributaries, Flood control, FLOWSED model, Levees, Sediment transport.

The FLOWSED model is a one-dimensional mathematical model for predicting open-channel unsteady flow conditions and sediment movement on the Ohio River. In this work the coefficients were selected to minimize sediment transport. FLOWSED, an implicit finite difference model, can be used to model a system containing any number of tributaries. The influences of locks and dams as well as levee overtopping are also included. This model cannot be applied to multiple connected systems with closed loops or distributary channels. FLOWSED was applied to the complete Ohio River systems, broken into four separate segments, in a calibration mode. Historical data from floods in 1964, 1972, and 1976 were used. Results at gages varied from excellent to encouraging. However, poor results were obtained on tributaries where crude geometry data were used.
W86-00220

CHANNEL WIDTHS IN BENDS AND STRAIGHT REACHES BETWEEN BENDS FOR PUSH TOWING: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00225

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 430-530; REPORT 6: LARVAL FISH STUDIES PILOT REPORT,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 6G.
W86-00226

GUIDE TO STREAM HABITAT ANALYSIS USING THE INSTREAM FLOW INCREMENTAL METHODOLOGY,

Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
For primary bibliographic entry see Field 6G.
W86-00251

2F. Groundwater

DISPERSION IN ANISOTROPIC, HOMOGENEOUS, POROUS MEDIA,

Baghdad Univ. (Iraq). Coll. of Engineering.
Q. N. Fattah, and J. A. Hoopes.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 810-827, May, 1985. 6 Fig, 1 Tab, 28 Ref, 1 Append.

Descriptors: *Dispersion, *Anisotropic media, *Homogenous media, *Porous media, *Groundwater movement, *Flow, Sand, Tensor models, Vectors, Model studies, Particle size, Path of pollutants.

A tensor model for the dispersion coefficient for saturated flow in anisotropic, homogeneous porous media was developed through evaluations of tensor components from experiments with an anisotropic, homogenous porous medium, constructed from thin, alternating layers of two types of sand, having different mean particle sizes. Tests were conducted for flow parallel, perpendicular, and inclined at 60 degrees to the direction of the layers. The hydraulic conductivity and the longitudinal dispersion coefficient were second-rank tensors with equal and constant eccentricities and with major and minor principal axes oriented along and perpendicular to the direction of the sand layers, respectively. The lateral dispersion coefficient was a second-rank tensor whose principal axes were orthogonal to those of the hydraulic conductivity tensor and whose eccentricity increased with increasing seepage velocity. Two values of the off-principal diagonal dispersivities were nearly equal in magnitude but opposite in sign. Experimental results support the dispersion coefficient tensor model proposed in the investigation. (Author's abstract)
W86-00015

FIELD OBSERVATIONS AND NUMERICAL EXPERIMENTS ON A DRYING FRONT IN A VOLCANIC ASH SOIL CALLED KANTO LOAM,

Rissho Univ., Tokyo (Japan). Dept. of Geography.
M. Higuchi.
Journal of Hydrology, Vol. 77, p 253-262, 1985. 5 Fig, 4 Ref.

Descriptors: *Drying fronts, *Soil water, *Volcanic ash soil, *Kanto loam, *Japan, *Evaporation, *Numerical analysis, Mathematical studies, Solar radiation, Wind, Boundary conditions, Loam.

Field observations (in Japan) and numerical experiments were carried out to investigate the formation and advance of a drying front in a volcanic ash soil called Kanto loam in an evaporation-drying process. The drying front is a boundary between an upward flux zone above and a downward flux zone beneath. In field observations of an evaporation-drying process from August 27 to September 8, 1977 in the Kanto loam, drying fronts formed quite near the soil surface and shift down to a depth of 100 cm. Numerical experiments for four different evaporation rates (respec. 1.25, 2.5, 5 and 10 mm/day) indicated that drying fronts advance downward to a depth of approximately 100 cm in 10 days. The computed depths of the drying fronts for an evaporation rate of 2.5 mm/day agree well with the observations. (Author's abstract)
W86-00038

BLOCK-GEOMETRY FUNCTIONS CHARACTERIZING TRANSPORT IN DENSELY FISSURED MEDIA,

British Geological Survey, Wallingford (England).
J. A. Baker.
Journal of Hydrology, Vol. 77, p 263-279, 1985. 2 Fig, 2 Tab, 22 Ref, 2 Append.

Descriptors: *Block-geometry functions, *Saturated zone, *Groundwater movement, *Solute transport, Diffusion, Heat, Geologic fractures, Path of pollutants, Laplace equation, Aquifers, Fick's law, Darcy's law, Fourier's law, Fourier analysis.

Three forms of transport are of importance in aquifers and saturated soils: transport of the water itself; transport of solutes in the water; and transport of heat by the water. Transport in saturated media can be considered to consist of densely packed blocks of matrix material separated by fis-

sures. The equations describing transport in fissured media, where transport in the matrix blocks is diffusive, are reduced to the standard form of a differential equation for the fissure phase. Transport in the matrix material is assumed to be diffusive which requires the following conditions to apply in the above three cases, respectively: water flow in the porous matrix is described by Darcy's law; water is stationary in the porous matrix and the solute transport is described by Fick's law; and water is stationary in the matrix, if it is porous, and heat transport is described by Fourier's law. Under these commonly assumed conditions the mathematical description of transport in the matrix phase will be the same in all three cases. The transport equations can be reduced to a differential equation for transport in the fissure phase along with its boundary conditions. This equation contains a dimensionless function, the block-geometry function, which contains all the relevant information regarding the geometry of the matrix blocks. Several such block-geometry functions were derived for simple shapes and for mixtures of these shapes. Empirical generalizations to irregular geometries were proposed on the basis of the commmon properties of these functions. The quasi-steady-state model of fissure-maxtrix interaction can also be formulated within this mathematical framework, and can be readily compared with the diffusive model, especially with regard to asymptotic behavior. Numerical Laplace transform inversion should be used for evaluation of the potential (head, concentration or temperature) except when the analytic solution is very simple. (Collier-IVI)
W86-00039

HYDRAULICS OF A WELL PUMPED WITH LINEARLY DECREASING DISCHARGE,

Govind Ballabh Pant Univ. of Agriculture and Technology, Plantnagar (India). Dept. of Irrigation and Drainage Engineering.
H. C. Sharma, H. S. Chauhan, and S. Ram.
Journal of Hydrology, Vol. 77, p 281-291, 1985. 7 Fig, 10 Ref.

Descriptors: *Hydraulics, *Discharge, *Wells, *Pumping, *Formation constants, *Aquifers, Theis equation, Cooper-Jacob equation, Model studies.

Varying the discharge rate of a well with time makes the Theis and Cooper-Jacob methods inapplicable for determination of the formation constants of an aquifer. Analytical and graphical solutions for variable discharge cases are available for a few empirical or functional relationships. A number of other modes of variation of discharge with time are physically possible. A method was developed with the help of analytical and graphical solutions to determine aquifer constants by pumping the well with linearly decreasing discharge. The linearly decreasing discharge was simulated on a horizontal Hele-Shaw model. The transmissivity and storage coefficient were evaluated by using the type curve developed for a linearly decreasing discharge well. The solution gave fairly satisfactory values of aquifer constants. (Author's abstract)
W86-00040

ANALYTICAL SOLUTIONS FOR PERIODIC WELL RECHARGE IN RECTANGULAR AQUIFERS WITH THIRD-KIND BOUNDARY CONDITIONS,

Thessaloniki Univ., Salonika (Greece). School of Technology.
P. Latinopoulos.
Journal of Hydrology, Vol. 77, p 293-306, 1985. 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Recharge, *Rectangular aquifers, *Aquifers, *Third-kind boundary conditions, *Boundary conditions, *Mathematical studies, Groundwater movement, Seasonal variation, Artificial recharge, Groundwater recharge, Perched aquifers.

Analytical solutions of groundwater flow in confined and unconfined homogeneous and isotropic aquifers are especially useful in understanding the physical processes on a local scale, as well as in checking numerical solutions for large-scale problems. Analytical solutions for groundwater flow in rectangular aquifers with third-kind boundary conditions in the case of a single-well recharging seasonally under any form of continuously varying recharge regime. The solutions can be used for a preliminary assessment of the groundwater response to artificial recharge schemes upon either perched aquifers or aquifers in contact with clogged river beds. Depending upon the desired final management goals, the most suitable recharge regime can be selected by trying various types of recharge rate variations at a first stage. The solutions can be used to check numerical solutions of large and more complex problems. (Collier-IVI)
W86-00041

REGIONAL UNSTEADY INTERFACE BETWEEN FRESH WATER AND SALT WATER IN A CONFINED COASTAL AQUIFER,

Ehime Univ., Matsuyama (Japan). Dept. of Ocean Engineering.
K. Inouchi, Y. Kishi, and T. Kakinuma.
Journal of Hydrology, Vol. 77, p 307-331, 1985. 12 Fig, 19 Ref.

Descriptors: *Saline-freshwater interface, *Coastal aquifers, *Confined aquifers, *Model studies, *Naka river estuary, *Kiki river estuary, *Japan, Aquifers, Groundwater level, Water level, Mathematical equations, Boundary conditions.

An areal two-dimensional model to describe the unsteady motion of the fresh-salt water interface and the groundwater level in a confined coastal aquifer was applied to the confined groundwater in the estuaries of the Naka and Kiki rivers in Japan. Two equations were derived starting from the basic equations of the groundwater flow; one equation of the effective water level and one equation of the interface. The first equation describes a very rapid variation of the effective groundwater level and the second equation describes a very slow variation of the interface with time. In order to find solutions of these equations under the boundary conditions in practical field problems, the numerical scheme based on Galerkin finite-element technique was employed. Using this numerical scheme, transient positions of the groundwater level and the interface were calculated in the above-mentioned two regions and compared with the available field data. The calculated results agreed well with the data. (Author's abstract)
W86-00042

TWO ALGORITHMS FOR PARAMETER ESTIMATION IN GROUNDWATER FLOW PROBLEMS,

Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
F. C. Van Geer, and P. Van Der Kloet.
Journal of Hydrology, Vol. 77, p 361-378, 1985. 7 Fig, 1 Tab, 4 Ref.

Descriptors: *Algorithms, *Groundwater movement, *Piezometric head, *Model studies, Darcys law, Kalman filtering, Mathematical studies, Pumping tests.

In groundwater flow problems the system variables are groundwater levels, piezometric levels and water velocities. The state of the system is defined in accordance with the continuous or discrete formulation of the variables which describe the groundwater flow model in time and space. Groundwater movement is often described by equations based on Darcy's law and the equation of continuity. These equations contain a number of lumped parameters, representing the properties of the soil. These parameters are not known and have to be estimated from field measurements (eg, pumping tests) or from calculations. Groundwater movement can be described by one lumped parameter; two algorithms were developed to estimate that parameter based upon an optimal-state estimation with a standard Kalman filter algorithm. In both methods, existing series of groundwater levels/piezometric levels can be used. The two algorithms were applied to an example with generated data. The estimation methods may be extended to cases with more than one parameter. Both methods allow insight in the variance of the parameter and in the reliability of the calculation results of the hydrological model. (Collier-IVI)
W86-00044

ALTERNATING DIRECTION GALERKIN TECHNIQUE FOR SIMULATION OF CONTAMINANT TRANSPORT IN COMPLEX GROUNDWATER SYSTEMS,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-00072

ANALYSIS AND INTERPRETATION OF SINGLE-WELL TRACER TESTS IN STRATIFIED AQUIFERS,

Auburn Univ., AL. Dept. of Civil Engineering.
O. Guven, R. W. Falta, F. J. Molz, and J. G. Melville.
Water Resources Research, Vol. 21, No. 5, p 676-684, May, 1985. 18 Fig, 22 Ref.

Descriptors: *Aquifer testing, *Advection, *Dispersion, Tracers, Model studies, Mathematical equations, Contamination, Path of pollutants, Groundwater pollution.

The definition and measurement of the dispersive properties of a stratified aquifer are investigated based on the single-well tracer test. In the single well test, tracer is pumped into the formation for a period of time and then pumped out. Concentration data are obtained from the injection-withdrawal well and from one or more sampling observation wells which may be multilevel. The analysis of such a test is based on a Lagrangian-Eulerian numerical model which considers the depth-dependent advection in the radial direction and local hydrodynamic dispersion in the vertical and radial directions. The movement of an injected tracer in a stratified aquifer may be accurately simulated without resorting to the use of a scale-dependent, full aquifer dispersivity if the flow field is known in sufficient detail. When the advection process is simulated accurately, the values of local dispersivity will be small, constant, and on the order of those measured in the field or lab at individual levels in the aquifer. The full aquifer breakthrough curves measured in observation wells in a single well test in a stratified aquifer are determined by the hydraulic conductivity profile in the region between the injection withdrawal well and the observation well if the travel distance between these wells is typical of most test geometries. The relative concentration versus time data recorded at the injection withdrawal well during the withdrawal phese is primarily a measure of mixing in the aquifer due to local dispersion which has taken place during the experiment. The amount of mixing will depend on both the hydraulic conductivity distribution in the aquifer and the size of the experiment. As the experiment scale increases, the effects of local vertical dispersion will become larger compared to the effects of local radial dispersion. Local vertical dispersion will cause solute traveling in a high conductivity layer in an aquifer to migrate into adjacent low-conductivity layers where its movement will be relatively slow in comparison. In the initial design of a tracer test it is important to have some idea of the type of nonhomogeneity which is present. More information of a broad nature concerning the types or classifications of nonhomogeneities that exist in natural aquifers is needed. (Baker-IVI)
W86-00074

STRATIGRAPHY AND SEDIMENTARY FACIES OF THE MADISON LIMESTONE AND ASSOCIATED ROCKS IN PARTS OF MONTANA, NEBRASKA, NORTH DAKOTA, SOUTH DAKOTA, WYOMING,

Geological Survey, Rolla, MO. Water Resources Div.
J. A. Peterson.
Available from the Distr. Br., USGS, 604 So. Pickett St., Alexandria, VA 22304. USGS Professional Paper 1273-A, 1984. 83 p, 34 Fig, 2 Tab, 88 Ref.

Descriptors: *Stratigraphy, *Hydrogeology, *Aquifers, Geologic units, Facies (Sedimentary), *Carbonate rocks, *Groundwater resources, *Sedimentary basins (Geologic), Permeability, *Madison Limestone, Paleogeography, Paleostructure, *Marker Beds, Reefs, *Carbonate Mounds, Montana, North Dakota, South Dakota, Wyoming, Nebraska.

The Madison Limestone study was begun in 1976 to evaluate the Madison Limestone and associated rocks as possible sources of water for the development of coal resources in the Northern Great Plains. Paleozoic sedimentary rocks in this area include a sequence of mostly shallow-water marine carbonate, clastic, and evaporite deposits of Middle Cambrian through Late Permian age. Upper Ordovician through Upper Mississippian rocks are primarily carbonate beds containing porous units, mainly dolomite or dolomitic limestone, which are widespread but discontinuous. The Devonian and Mississippian sediments are cyclic deposits, and the Mississippian carbonate rocks can be divided into at least 13 carbonate-evaporite marker-defined cyclic units, based on the common occurrence of shaly marker beds, identified on geophysical logs. The Upper Paleozoic rocks are dominated by clastic rocks, beginning with the marine shales, carbonates, redbeds and evaporites of the Upper Mississippian and ending with the relatively thick marine and aeolian sandstones, red beds, and evaporites of Pennsylvanian and Permian age. Thick, porous sandstone beds occur in Upper Pennsylvanian and Lower Permian rocks of Wyoming, southeastern Montana, northwestern South Dakota, and southwestern North Dakota. (USGS)
W86-00104

ANALYSIS AND INTERPRETATION OF DATA OBTAINED IN TESTS OF THE GEOTHERMAL AQUIFER AT KLAMATH FALLS, OREGON,

Geological Survey, Menlo Park, CA. Water Resources Div.
E. A. Sammel.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4216, 1984. 151 p, 65 Fig, 7 Tab, 68 Ref.

Descriptors: *Hydrogeology, *Reconnaissance, *Geothermal resource, Evaluation, Geology, *Oregon, Klamath County, Klamath Falls.

Water with temperatures to 130 C occurs in an extensive, heterogeneous aquifer at depths of a few hundred to nearly 2,000 feet. Chemical and isotopic analyses suggest that 190 C water mixes with cooler recharge water in a ratio of about 2 to 3 in zone within and beneath the aquifer. The water spreads from a fault zone and is tapped for space heating by more than 450 wells over a 2 square-mile area. Data obtained during a 50-day pumping and reinjection test in July and August, 1983, were fitted to theoretical double-porosity type curves. Predictions of water-level changes were made for two hypothetical pumping and reinjection schemes. It was determined that reinjection can generally offset declines due to pumping, although water levels will decline near pumped wells and will rise near injection wells. Tracer tests confirmed the double-porosity behavior of the aquifer. Discharge from thermal wells averages about 540 gallons per minute and heat discharge is about 18 x 10 to the 12th power British Thermal Units per year. Down-hole heat exchangers discharge about 13 x 10 to the 10th power British Thermal Units per year. Additional development probably is feasible. (USGS)
W86-00107

WATER RESOURCES ON THE PUEBLO OF LAGUNA, WEST-CENTRAL NEW MEXICO,

Geological Survey, Albuquerque, NM. Water Resources Div.
D. W. Risser, and F. P. Lyford.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4038, 1983. 308 p, 42 Fig, 17 Tab, 45 Ref.

Descriptors: *Groundwater availability, *Surface water availability, *Groundwater movement, *Water quality, Computer modeling, *Aquifer testing, Pueblo of Laguna, *New Mexico, Bernalillo, Sandoval County, Valencia County, Cibola County, Rio San Jose Basin.

This study evaluates the quality and quantity of water available on the Pueblo of Laguna, New Mexico. Groundwater for public supply occurs in the valley fill along the Rio San Jose, in the Paguate and Encinal areas, and possibly in the northern part of the Sedillo Grant. The valley fill in the Rio San Jose will supply 50 to 450 gallons per minute of potable water to properly constructed wells. In the alluvium along Rio Paguate, additional development of as much as 250 gallons per minute is possible. Groundwater for irrigation is restricted by available yields and quality to the valley fill along the Rio San Jose and possibly the western part of the Major's Ranch area. In the Rio San Jose valley yields of 50 to 450 gallons per minute of water containing 500 to 3,000 milligrams per liter are possible. Digital-model simulations of the valley-fill aquifer west of the Village of Laguna show a potential salvage of as much as 900 acre-feet per year of evapotranspiration losses if water levels are lowered. Model studies also indicate that the winter flow of the Rio San Jose could be used to recharge groundwater stored in the valley. (USGS)
W86-00108

GROUND-WATER RESOURCES OF AUDRAIN COUNTY, MISSOURI,

Geological Survey, Rolla, MO. Water Resources Div.
L. F. Emmett, and J. L. Imes.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-245, 1984. 55 p, 38 Fig, 8 Tab, 34 Ref.

Descriptors: *Computer model, *Groundwater movement, Groundwater irrigation, *Drawdown, *Potentiometric surface, Wells, Water supply, Groundwater availability, *Missouri, Audrain County, Enroachment, Water use, Water quality, Consolidated aquifer.

The deep (principal) aquifer in Audrain County has an average thickness of about 1,300 feet and is composed of dolomite and minor quantities of sandstone of Cambrian and Ordovician age. The deep aquifer is the source of water for all public-supply and irrigation wells in Audrain County. Pumpage from the deep aquifer has caused a decrease in hydraulic head of more than 200 feet since 1900 in the vicinity of the city of Mexico. Calculations from a two-dimensional digital model of the deep aquifer indicate that the drawdown would increase 10 to 25 feet from May 1979 levels in Audrain County by May 2000 in the absence of irrigation pumpage and if public-supply wells continue to pump at the 1980 rate. If the additional stress due to seasonal irrigation is continued at 1980 pumping rates, 60 +/- 20 feet of drawdown is predicted by May 2000. Audrain County is the northernmost extent of freshwater in this aquifer in Missouri. In Audrain County the dissolved-solids concentration of water from this aquifer varies from 1,200 milligrams per liter in the north to less than 400 milligrams per liter in the south. Lowered water levels in the aquifer may allow water with a larger dissolved-solids concentration to move into the area. (USGS)
W86-00113

WATER TABLE IN ROCKS OF CENOZOIC AND PALEOZOIC AGE, 1980, YUCCA FLAT, NEVADA TEST SITE, NEVADA,

Geological Survey, Lakewood, CO. Water Resources Div.
G. C. Doty, and W. Thordarson.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4067, 1983. 1 p (cover), 1 Fig (map).

Descriptors: *Water table, *Maps, *Nevada, Groundwater resources, Hydrogeology, Yucca Flat, Nevada Test Site, *Nye County.

The water table at Yucca Flat, Nevada Test Site, Nevada, occurs in rocks of Paleozoic age and in tuffs and alluvium of Cenozoic age and ranges in altitude from about 2,425 feet to about 3,500 feet. The configuration of the water table is depicted by contours with intervals of 25 to 500 feet. Control for the map consists of water-level information from 61 drill holes, whose locations and age of geologic units penetrated are shown by symbols on the map. (USGS)
W86-00116

GROUND-WATER CONDITIONS IN THE COTTONWOOD-WEST OAKLEY FAN AREA, SOUTH-CENTRAL IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
T. K. Edwards, and H. W. Young.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4140, 1984. 32 p, 12 Fig, 3 Tabs, 22 Ref.

Descriptors: *Groundwater development, *Water table decline, *Groundwater depletion, Groundwater barriers, *Aquifer testing, *Overdraft, *Idaho, Golden Valley, Cottonwood-West Oakley Fan, Rock Creek Hills, Critical Groundwater Area.

Intensive groundwater development in the Cottonwood-West Oakley Fan area, Cassia County, Idaho, has resulted in rapid water-level declines and establishment of two critical groundwater areas. A northwest-trending fault in nearly coincident with the boundary between the two critical groundwater areas. Southwest of the fault, water levels in limestone are as much as 200 feet higher than those in silicic volcanics northeast of the fault, which indicates the fault is an effective barrier to groundwater movement. Results of an aquifer test in limestone southwest of the fault further indicate no hydraulic connection with the silicic volcanics aquifer northeast of the fault. Water levels in wells completed in limestone and silicic volcanics aquifers have declined 5 and 5.5 feet per year since 1977. Groundwater withdrawals in 1980 were about 60,000 acre-free from the silicic volcanics aquifer and, between 1977 and 1982, averaged about 5,300 acre-feet per year from the limestone aquifer. Annual recharge to the silicic volcanics aquifer is between about 10,000 and 26,000 acre-feet; recharge to the limestone aquifer is near 4,000 acre-feet. Limited water-quality data indicate the groundwater is chemically suitable for irrigation and domestic use. (USGS)
W86-00117

STREAMFLOW LOSSES ALONG THE BALCONES FAULT ZONE, NUECES RIVER BASIN, TEXAS,

Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-00124

AVAILABILITY OF WATER FROM THE ALLUVIAL AQUIFER IN PART OF THE GREEN RIVER VALLEY, KING COUNTY, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
W. E. Lum, II, R. C. Alvord, and B. W. Drost.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4178, 1984. 38 p, 12 Fig, 4 Tab, 5 Ref.

Descriptors: *Computer model, Groundwater availability, *Groundwater, *Well yield, Water resources development, Streamflow depletion, *Surface-groundwater relationships, Potential water supply, *Alluvial aquifers, Green River, King County, *Washington.

The Muckleshoot Indian Tribe plans (1982) to build a fish hatchery in part of a 1.56-square-mile area in the Green River valley, Washington, and use groundwater to operate it. Groundwater data

were collected in the area and used in a U.S. Geological Survey two-dimensional groundwater-flow model calibrated to simulate the groundwater-flow system in the study area. Measured water levels in the alluvial aquifer were simulated to within 1 foot at 7 of 12 observation wells, and within 2 feet at all 12 wells. When pumping from the aquifer was simulated with the model, it was found that all water pumped from wells was derived from induced leakage from the Green River into the alluvium and reduced leakage through the alluvium to the Green River. Pumping from the alluvium may also reduce the flow of a tributary to the Green River. (USGS)
W86-00126

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1981 VOLUME 1: NORTHEAST FLORIDA.
Geological Survey, Orlando, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00127

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1982, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00128

WATER RESOURCES DATA HAWAII, OTHER PACIFIC AREAS, WATER YEAR 1981. VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRONESIA, PALAU ISLANDS AND AMERICAN SAMOA.
Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00130

NATURAL GROUND-WATER-RECHARGE DATA FROM THREE SELECTED SITES IN HARVEY COUNTY, SOUTH-CENTRAL KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
C. A. Perry.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-457, 1984. 31 p, 7 Fig, 7 Tab, 4 Ref.

Descriptors: *Data collections, Soil water, *Groundwater level, Rainfall, *Recharge, *Kansas, Equus beds, Recharge data.

The cities of Wichita, Newton, and several smaller towns pump large quantities of water from the 'Equus Beds' aquifer in south-central Kansas. The aquifer also supplies large quantities of water for irrigation at a steadily increasing rate. The Harvey County Planning and Zoning Commission entered into a cooperative agreement with the U.S. Geological Survey to collect information on natural recharge at three sites having different soils and unsaturated lithologies. Data summarized in tabular form include daily rainfall amounts, average soil moisture for selected layers, water-table levels, and neutron-measured soil moisture at 1-foot intervals. This information can be used in studying the possibility of protecting the aquifer from any developement that might impede natural recharge. (USGS)
W86-00132

USER'S GUIDE FOR A PLANE AND AXISYMMETRIC FINITE ELEMENT PROGRAM FOR STEADY-STATE SEEPAGE PROBLEMS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing Center.
For primary bibliographic entry see Field 2G.
W86-00156

PUBLIC WATER SUPPLIES IN GLOUCESTER COUNTY, N.J.,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. F. Hardt.
Water Resources Circular No. 9, New Jersey State Dept. of Conservation and Economic Development, 1963. 55 p, 4 Fig, 5 Tab, 8 Ref.

Descriptors: *Municipal water, *Water supply, *Water demand, *Water use, *Potential water supply, Water quality, Groundwater, Water conveyance, Aquifers, Geohydrology, Pumping plants, Saline water intrusion.

Gloucester County is part of the Lower Delaware River Valley in New Jersey. This area is attracting new industry and has shown a population increase of about 47% from 1950-1960. The availability and quality of water is becoming more important with the economic growth of the county. Gloucester County is underlain by unconsolidated sands and clays of Quaternary, Tertiary, and Cretaceous age. The Raritan and Magothy Formations constitute the most important aquifers and yield more than 95% of the water pumped by the public water systems in the county. These formations are capable of yielding 1,400 gallons per minute (gpm) or more to large diameter wells. The overall chemical quality of the groundwater is good. Contamination of groundwater by salt-water encroachment or by pollution from industrial activity or organic waste in densely populated areas should be prevented. The 21 public water systems in Gloucester County realized 100% increase in pumped water from 1948 to 1959. The history of the present installations, groundwater conditions, quality and availability of water, and potential future yield for the 21 public water systems in Gloucester County are summarized.
W86-00174

SEEPAGE ANALYSIS USING THE BOUNDARY ELEMENT METHOD,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2G.
W86-00228

2G. Water In Soils

SOIL MOISTURE CONTENT: STATISTICAL ESTIMATION OF ITS PROBABILITY DISTRIBUTION,
Kozponti Meteorologiai Intezet, Budapest (Hungary).
T. Farago.
Journal of Climate and Applied Meteorology, Vol. 24, No. 4, p 371-376, April, 1985. 3 Fig, 29 Ref.

Descriptors: *Soil water, *Statistical analysis, *Precipitation, Surface water, Markov process, Mathematical studies, Meteorology.

The simplified surface-water balance equation was generalized so as to express the probability distribution of its soil moisture component in a recurrence form; an extended probability model for soil moisture was derived based on a chain-dependent model for precipitation. A similar equation was deduced for the first moments as well. The consideration of the stochastic dependence of the consecutive daily precipitation amounts is usually unavoidable for periods essentially shorter than one month. Gamma distributions were used in fitting the stochastic variables of daily precipitaiton amounts. The model could have been solved only in an approximate numerical way due to its complexity. Nevertheless, either the distribution function, or, in a simpler case, the mean value of soil moisture can effectively be estimated given all parameters of the Markov process of daily precipitation, an initial value of the soil moisture and the coefficient of parameterization of other terms in the water balance equation. Such a parameterization is acceptable under the conditions of insufficient humidification. The model is illustrated by a numerical example. (Collier-IVI)
W86-00021

BLOCK-GEOMETRY FUNCTIONS CHARACTERIZING TRANSPORT IN DENSELY FISSURED MEDIA,
British Geological Survey, Wallingford (England).
For primary bibliographic entry see Field 2F.
W86-00039

COMPARING THE PERFORMANCE OF ROOT-WATER-UPTAKE MODELS,
Katholieke Univ. Leuven (Belgium). Lab. of Soil Physics.
For primary bibliographic entry see Field 2D.
W86-00048

INFILTRATION UNDER PONDED CONDITIONS: 1. OPTIMAL ANALYTICAL SOLUTION AND COMPARISON WITH EXPERIMENTAL OBSERVATIONS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J. Y. Parlange, R. Haverkamp, and J. Touma.
Soil Science, Vol. 139, No. 4, p 305-311, April, 1985. 4 Fig, 13 Ref.

Descriptors: *Infiltration, *Ponding, *Mathematical equations, Water depth, Numerical analysis, Soil water, Differential equations, Mathematical studies.

Under ponded infiltration the cumulative infiltration is a function of soil properties, initial conditions, and water layer thickness above the soil surface. A simple analytical infiltration formula predicted the cumulative infiltration as a function of time when the soil surface is ponded. For arbitrary soil properties and arbitrary dependence of water layer thickness on time but uniform initial water content, the optimization technique predicts the cumulative infiltration from the integration of an ordinary differential equation. If the thickness of the water layer is constant with time, integration of the differential equation yields a fully analytical result. When the water layer thickness is small, the infiltration rate is significantly different from the standard Green and Ampt result; as the layer thickness increases, the Green and Ampt result becomes increasingly accurate. Comparison with a laboratory infiltration experiment illustrated the validity of the present infiltration expressions. (Collier-IVI)
W86-00049

SOIL WATER EVAPORATION SUPPRESSION BY SAND MULCHES,
Iowa State Univ., Ames. Dept. of Agronomy.
A. S. Modaihsh, R. Horton, and D. Kirkham.
Soil Science, Vol. 139, No. 4, p 357-361, April, 1985. 4 Fig, 11 Ref.

Descriptors: *Soil water, *Evaporation, *Mulches, *Sand mulch, Mulching, Evapotranspiration control, Crop production.

Experiments were performed to study sand as a soil mulch with the objective of determining the comparative effectiveness of 0-, 2-, and 6-cm-thick covering sand layers in suppressing evaporation from columns of soil. Measurements were made by using potential evaporation rates of 1.1 and 0.55 cm/d. In addition to evaporation, soil water distribution with depth was measured for the different sand-cover treatments. Five treatments were studied: check (no sand mulch), 6 cm of coarse sand (C6), 6 cm of fine sand (F6), 2 cm of coarse sand (C2), and 2 cm of fine sand (F2). After 35 d of experiment, the cumulative evaporations for the check, C6, F6, C2, and F2 treatments were measured as 6.79, 1.50, 1.55, 3.76, and 4.62 cm of water, respectively, at a potential evaporation of 1.1 cm/d and, for the potential evaporation of 0.55 cm/d, was correspondingly 6.68, 0.95, 1.21, 2.71, and 4.28 cm. These sets of numbers show that there was marked evaporation reduction for the sand mulches with respect to bare soil (check). The 6-cm sand mulches were the most effective evaporation suppressors. For equal mulch thickness, coarse sand was only slightly more effective than fine sand. Results from soil water distributions with depth for the various treatments also indicated that

the sand mulches were effective in conserving soil water against evaporation losses. The mulches were effective in this order: C6 > F6 > C2 > F2. (Author's abstract)
W86-00050

NUMERICAL CALCULATION OF SATURATED-UNSATURATED INFILTRATION IN A CRACKED SOIL,

Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics.
M. R. Davidson.
Water Resources Research, Vol. 21, No. 5, p 709-714, May, 1985. 6 Fig, 14 Ref.

Descriptors: *Infiltration, *Soil water, Saturated flow, Unsaturated flow, Rainfall, Runoff, Mathematical equations, Wetting.

Infiltration in a nonswelling homogeneous soil containing regularly spaced, water filled, vertical cracks is calculated from a finite difference solution of the saturated-unsaturated flow equations. The numerical scheme is implicit with iteration based on the linear method of successive overrelaxation and uses a correction technique to prevent the accumulation of small iteration errors with time. Results agree well with those derived from a Green-Ampt model. Differences in cumulative infiltration and infiltration rates, expressed as percentages of the corresponding finite difference solution, are usually no more than about 4% and can be much less. Calculations predict that when the magnitude of the moisture potential at the wetting front in low, the persistence of mushrooming of wetted tongues moving out of adjacent cracks results in the formation of an unwetted pocket centered on the line of symmetry when the crack spacing depth ratio is also small. As the pocket fills the infiltration rate exhibits a sudden drop caused by a corresponding rapid fall in lateral potential gradients. As moisture potential at the wetting front becomes more negative, the depth of penetration by the zone of positive pressure decreases, although penetration by the wetting front increases. (Baker-IVI)
W86-00078

EVALUATION OF HYDROLOGIC PROCESSES AFFECTING SOIL MOVEMENT IN THE HAGERMAN FAUNA AREA, HAGERMAN, IDAHO,

Geological Survey, Boise, ID. Water Resources Div.
H. W. Young.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4137, 1984. 17 p, 4 Fig, 1 Tab, 2 Ref.

Descriptors: Soil stability, *Erosion, *Perched ground water, Springs, *Agricultural runoff, *Seepage loss, Erosion control, *Idaho, Hagerman fossil beds.

The Hagerman fauna area on the western slope of the Snake River canyon in south-central Idaho is one of the most important locations of upper Pliocene fossils in the world. The fossil beds are distributed vertically through a 500-foot stratigraphic section of the Glenns Ferry Formation. Accelerated soil movement caused by surface-water runoff from irrigated farmlands on the plateau above the canyon and discharge from springs and seeps along the slope of the canyon is eroding the fossil beds. Source of the springs and seeps is a perched aquifer, which is probably recharged by seepage losses from two irrigation canals that head near the canyon rim. Annual canal losses are about 1,900 acre-feet. Annual discharge from springs and seeps is about 420 acre-feet. Corrective measures that could be taken to stabilize the soil movement and preserve the fauna area include: (1) Lining or treating the canals, (2) eliminating the practice of flushing irrigation systems, (3) constructing road berms and cross dips, and (4) establishing an uncultivated strip of land between irrigated farmlands and the canyon rim. (USGS)
W86-00119

USER'S GUIDE FOR A PLANE AND AXISYMMETRIC FINITE ELEMENT PROGRAM FOR STEADY-STATE SEEPAGE PROBLEMS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing Center.
F. T. Tracy.
Instruction Report K-83-4, September 1983. Final Report. 58 p, 21 Fig, 1 Append.

Descriptors: *Seepage, *Computer programs, *Mathematical models, Finite element method, Laminar flows, Laplace equation, Darcy's Law, Soil water movement, Groundwater movement.

This report is a user's guide for a plane and axisymmetric finite element method (FEM) computer program for solving steady-state seepage problems. Confined or unconfined, homogeneous or nonhomogeneous, and isotropic or anisotropic problems can be solved. Laplace's Equation and Darcy's Law, the equations governing laminar flow through porous media, are the basis for the analysis. Input to the program consists basically of permeability data, node data, and element data. Output from the program consists of heads at the nodes, discharge velocities at the element centers, and a postprocessor file. For unconfined problems, a description of the resulting phreatic surface is also given. The report also contains some sample problems and a brief description of the theory. (Author)
W86-00156

SEEPAGE ANALYSIS USING THE BOUNDARY ELEMENT METHOD,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
A. K. Chugh, and H. T. Falvey.
REC-ERC-83-11, May 1984. 55 p, 15 Fig, 3 Tab, 18 Ref, Append.

Descriptors: *Groundwater movement, *Seepage, *Soil water movement, *Infiltration, Computer models, Model studies, *Mathematical models, Steady flow, Dams, Foundations, Boundary conditions, Boundary element method, Anisotropy.

A simple and effective extension of the boundary element method for solving basic equation of steady flow in isotropic soil is presented to solve steady confined or steady unconfined flow problems or both in zoned anisotrophic mediums. A computer program listing in FORTRAN IV and a set of user's instructions are included to facilitate the use of the computer program. Only steady-state seepage problems in two-dimensional domains with general distribution of piecewise homogeneous material zones are considered. Sample problems illustrating the use of the computer program and the accuracy of results are given. (Author)
W86-00228

2H. Lakes

SEASONAL SUCCESSION OF PHYTOPLANKTON IN LAKE CONSTANCE,

Konstanz Univ. (Germany, F.R.). Limnological Inst.
U. Sommer.
BioScience, Vol. 35, No. 6, p 351-357, June, 1985. 3 Fig, 49 Ref.

Descriptors: *Seasonal variation, *Succession, *Phytoplankton, *Lake Constance, *Austria, *Switzerland, *West Germany, Stratification, Physicochemical properties, Species composition, Mixing, Destratification.

Phytoplankton succession, the physical and chemical environment, photosynthesis, zooplankton production and population dynamics, bacterio-plankton, and algal sedimentation were studied between 1979 and 1982 on Lake Constance (West Germany, Austria, and Switzerland) and phytoplankton nutrient competition was studied in steady-state and pulsed-state systems. The results of these studies were reviewed in an analysis of the relative importance of temperature, stratification, light, competition for resources, sedimentation, and losses to heterotrophic compartments of the trophic chain in controlling seasonal shifts in phytoplankton species composition and how the importance of those factors varies during the year. In Lake Constance, the phytoplankton growth season starts when stratification begins in spring. The seasonal pattern of stratification and mixing is the master environmental variable in deep lakes like Lake Constance. Temperature and sedimentation turn out to be less important in succession than traditionally assumed. Initially, maximum growth rates are favored; later, as the water column stabilizes, zooplankton grazing and competition for nutrients become the dominant selective forces. When the mixing depth increases in autumn, algae that can tolerate low light are selected for. During the mixing period in winter, significant algal growth is impossible, the organisms become scarce, most nutrients remain unconsumed in solution, the water becomes highly transparent, and grazing and competition play no role. Shifts in species composition are caused by long-term, regular losses of water column stability, such as the autumn increase in mixing depth. (Collier-IVI)
W86-00051

GROUNDWATER SEEPAGE NUTRIENT LOADING IN A FLORIDA LAKE,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
T. V. Belanger, D. F. Mikutel, and P. A. Churchill.
Water Research, Vol. 19, No. 6, p 773-781, 1985. 3 Fig, 9 Tab, 20 Ref.

Descriptors: *Groundwater movement, *Nutrient loading, *East Lake Tohopekaliga, *Florida, *Seepage, Lakes, Water quality, Piezometers, Seepage meters, Hydrologic budget.

Twenty-five seepage meters were positioned in East Lake Tohopekaliga, Florida, to determine groundwater seepage contributions of water and nutrients to the lake in 1983. Seepage was found to be an important source of water to the lake, contributing 14.3% of the water sources, and rates decreased significantly ($P < 0.01$) with distance from shore. A comparison of the piezometer and seepage meter techniques for measuring nutrient loading to the lake indicates the direct seepage meter technique overestimated nutrient inputs due to the enclosure to the sediments, possibly resulting in anaerobic conditions and increased release rates of ammonium nitrogen and phosphate. These results suggest that past studies employing this technique may be in error. Nutrient loading, calculated from piezometer nutrient data and seepage meter flow data, show that the groundwater nutrient loading in the lake was significant, contributing 8.7 and 17.6% of the total phosphorus and total nitrogen inputs to the lake, respectively. (Author's abstract)
W86-00065

UNIFIED THEORY FOR MICROBIAL GROWTH UNDER MULTIPLE NUTRIENT LIMITATION,

Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
C. Y. Chen, and E. R. Christensen.
Water Research, Vol. 19, No. 6, p 791-798, 1985. 6 Fig, 2 Tab, 17 Ref. U.S. NSF grant CEE 8103650.

Descriptors: *Microbial growth models, *Limiting nutrients, *Model studies, Threshold models, Product models, Growth kinetics, Growth rates.

A unified theory for microbial growth under multiple nutrient limitation is presented. The theory has a probabilistic foundation and gives the well-known threshold and product models as special cases. The threshold model is obtained for full correlation of cell division activation levels which would occur for a single species from a single clone, growing synchronously. In contrast, the product model applies to zero correlation of the activation levels which is likely to be found in a mixed culture. The growth kinetics for each limiting nutrient acting separately, while others are at saturation, can be any of the well-known types;

e.g. Monod or exponential, or the more general logit (Moser) and Weibull models. The Weibull model is given a novel probabilistic basis. (Author's abstract)
W86-00067

NITROGEN AND PHOSPHORUS SPECIATION AND FLUX IN A LARGE FLORIDA RIVER WETLAND SYSTEM,

Geological Survey, Tallahassee, FL.
J. F. Elder.
Water Resources Research Vol.21, No. 5, p 724-732, May, 1985. 7 Fig, 4 Tab, 51 Ref.

Descriptors: *Wetlands, *Florida, *Apalachicola River, *Nitrogen, *Phosphorus, Nutrients, Suspended sediments, Chemical speciation, Dissolved solids, Nitrates, Particulate matter, Organic compounds.

Nutrient flux was examined in a river wetland system in northern Florida, the Apalachicola River system. The nutrient species differed substantially in the amount of net import or export from the Apalachicola River wetland system. The changes in TN and NO3-N were within the expected error of estimate, and therefore the system cannot be considered either a source or a sink for total or nitrate nitrogen. Significant net changes did occur for other nitrogen species. The system showed a distinct tendency to yield organic nitrogen, both dissolved and particulate, while consuming ammonia nitrogen. These counterbalancing processes are masked by investigation of total nitrogen alone. The flux of ammonia nitrogen was notably different from other species. The behavior of phosphorus was similar to that of nitrogen. Soluble reactive phosphorus decreased, indicating consumption within the system, whereas the remaining dissolved phosphorus showed a net yield. There appeared to be a net yield of particulate and total phosphorus, but the percent changes were barely above errors of estimate. The soluble reactive phosphorus (SRP) budget was similar to that of NH4-N. Import within the system was evident, and the loads at the headwaters and mouth of the river were nearly equal. Input by precipitation was also a significant source of SRP, approaching 10% of the total outflow. For all nitrogen and phosphorus species the predominant source was inflow from the upper watershed near Chattahoochee. The Chipola River was the second major contributor for most species. Groundwater, precipitation, and surface water runoff contributed only a small portion of the total riverine nutrient load. The relative errors of estimate of these components are larger than those of the riverine components, but the overall budget is not appreciably affected by error factors associated with small components. (Baker-IVI)
W86-00080

HISTORICAL CHANGES TO LAKE WASHINGTON AND ROUTE OF THE LAKE WASHINGTON SHIP CANAL, KING COUNTY, WASHINGTON,

Geological Survey, Seattle, WA. Water Resources Div.
M. J. Chrzastowski.
USGS Water-Resources Investigation Report 81-1182, 1983. 39 p, 6 Fig, 1 Tab, 41 Ref.

Descriptors: *Historical shoreline, *Shorelines, *Wetlands, *Shoreline changes, *Canals, Stream loss, Landfill, Land-use planning, Stream diversions, Lakes, Lake hydrology, Maps, *Washington, Seattle, *Lake Washington, Lake Washington Ship Canal, Lake Union, Salmon Bay, Sammamish River, Cedar River, Black River, Duwamish River, Renton, Ballard, Hiram M. Chittenden Locks, Shilshole Bay.

Historical shoreline changes to hydrologic characteristics were studied for Lake Washington and the route of Lake Washington Ship Canal. The study is based on comparison of maps made during the period 1875-1907 and modern topographic maps, supplemented with historical documents that describe the once-natural setting of the lakes and streams in the Lake Washington drainage basin. The observed shoreline changes range from minor to substantial. The water-surface area has been historically reduced by about 6 square kilometers, and total shoreline has been reduced by 20 kilometers. Approximately 4 square kilometers of the historical wetland area has been eliminated, or about 93 percent of the natural wetland extent. The changes have resulted from construction of the Lake Washington Ship Canal and accompanying water-level adjustments, shoreline modification from urban growth of the area, and limited natural processes. The map comparison documents (1) extent of shoreline changes (2) historical loss of wetlands area, (3) loss of small streams that historically entered the lakes and bays, and (4) historical vegetation and land-use patterns around the lakeshore and canal route. The identification of historical shorelines, wetlands, and small streams that have no expression on today's landscape is information of value to land-use planning and local engineering activities. (USGS)
W86-00105

PRELIMINARY EVALUATION OF LAKE SUSCEPTIBILITY TO WATER-QUALITY DEGRADATION BY RECREATIONAL USE, ALPINE LAKES WILDERNESS AREA, WASHINGTON,

Geological Survey, Seattle, WA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W86-00114

COEFFICIENTS FOR USE IN THE U.S. ARMY CORPS OF ENGINEERS RESERVOIR MODEL, CE-QUAL-R1,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5B.
W86-00153

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM PLANTS: SELECTED LIFE HISTORY INFORMATION OF ANIMAL SPECIES ON LAKE CONWAY, FL,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 4A.
W86-00197

VOLUNTEER LAKE MONITORING, 1981,

Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
For primary bibliographic entry see Field 5C.
W86-00200

PHYTOPLANKTON-ENVIRONMENTAL INTERACTIONS IN RESERVOIRS, VOLUME II: DISCUSSION OF WORKSHOP PAPERS AND OPEN LITERATURE,

Tetra Tech, Inc., Bellevue, WA.
M. W. Lorenzen, D. B. Porcella, and T. M. Grieb.
Technical Report E-81-13, September 1981. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 104 p, 3 Fig, 10 Tab, 101 Ref. Contract/Grant No. DACW39-78-C-0088.

Descriptors: *Lake, *Reservoirs, *Phytoplankton, *Algae, *Environmental effects, *Water quality, Model studies, Mixing, Dissolved oxygen, Oxygen, Aesthetics, Trophic level, Eutrophication, Data collections, Sampling, Numerical analysis, Mathematical models, Simulation analysis, Nutrients, Grazing, Limnology, Fish, Chlorophyll, Temperature effects, Photosynthesis.

This report is a supplement to the Proceedings of the Workshop on Phytoplankton-Environmental Interactions in Reservoirs. It is organized to provide a general perspective and interpretation of the knowledge about phytoplankton behavior in reservoirs and to discuss techniques for reservoir study. Topics included are phytoplankton effects on water quality (mixing, vertical zones, and clarity; dissolved oxygen; aesthetic effects; trophic levels), techniques for reservoir study (data collection, multivariate numerical analysis, loading models, simulation models), and reservoir phytoplankton models, (utility, algal production and loss, transport, temperature, light, nutrients, grazing, typical formulations, growth and death rates, and recommended formulations).
W86-00206

LOCATIONS AND AREAS OF PONDS AND CAROLINA BAYS AT THE SAVANNAH RIVER PLANT,

Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
J. D. Shields, N. D. Woody, A. S. Dicks, G. J. Hollod, and J. Schalles.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82015381. DP-1525 (Rev. 1), May 1982. 19 p, 7 Fig, 2 Tab, 4 Ref. Contract/Grant No. DE-AC09-76SR00011.

Descriptors: *Lakes, *Ponds, *Carolina bays, Shallow water, Savannah River Plant, South Carolina.

The U.S. Department of Energy's Savannah River Plant, a 192,000-acre site in South Carolina, contains 28 ponds and 190 Carolina bays. Carolina bays are defined as elliptical depressions, usually oriented northwest-southeast, with no apparent inlet or outlet. Pat Pond, the largest pond, is 2500 acres. The mean pond area, not including Par, is 17.6 acres (range, 0.4-202.8 acres). The mean area for Carolina bays is 6.6 acres (range, 0.3-124.0 acres). Not all Carolina bays hold water; however, higher soil moisture than the surrounding land is often indicated by aquatic vegetation.
W86-00263

PONDS AND LAGOONS OF HORN AND PETIT BOIS ISLANDS, MISSISSIPPI, GULF ISLANDS NATIONAL SEASHORE: THEIR PHYSICAL SIZE, LITERATURE REVIEW AND RECOMMENDATIONS FOR FUTURE RESEARCH,

National Space Technology Labs., NSTL Station, MS.
S. Shabica, and J. Watkins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-137067. National Park Service, Research/Resources Management Report SER-60, January 1982. 29 p, 3 Fig, 8 Tab, 12 Ref.

Descriptors: *Ponds, *Lagoons, *Aquatic life, Oysters, Fish, Horn Island, Petit Bois Island, Gulf Islands National Seashore, Vegetation, Brackish water, Tide lands, Mississippi.

The physical size of bodies of water on Petit Bois Island and Horn Island, Mississippi, was surveyed. Petit Bois Island contains 17 ponds and lagoons (0.17 to 18.04 hectares each) covering a total of 46.26 acres, 3.2% of the island's area. Horn Island has 63 ponds and lagoons (0.08 to 53.63 hectares each) covering a total of 191.58 acres, 5.8% of the island's area. These ponds and lagoons, all brackish, are concentrated on the eastern, geologically oldest, most stable portions of the islands. Since a 1965-1966 survey, 17 ponds on Horn Island have remained relatively stable, 12 water bodies have evolved into 5 discrete ponds, 19 water bodies ceased to exist, and 38 new water bodies have evolved into ponds. The literature on vegetation, fish, and oysters is reviewed. Recommendations for future research are made. Several of these concern aquatic life, particularly fish and oysters.
W86-00278

WAVE DATA ACQUISITION AND HINDCAST FOR SAGINAW BAY, MICHIGAN,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
A. W. Garcia, and R. E. Jenssen.
Technical Report HL-83-14, June 1983. Final Report. 69 p, 31 Fig, 4 Tab, 26 Ref, 2 Append.

Descriptors: *Lakes, *Waves, *Data acquisition, Saginaw Bay, Michigan, Storms, Wave height, Model studies, Hindcast models, Wind, Lake Huron, Damage, Adsorption, Shallow water.

A wave-measurement system was deployed in Saginaw Bay, Michigan, for the purpose of determining the wave growth within the bay as functions of fetch and time. The wave data acquired provide the basis for development and verification of a shallow-water wave hindcast model. The hindcast model, along with 20 years of wind data, is used to perform and extremal analysis of wave conditions within Saginaw Bay. Results of the analysis show that a maximum significant wave height of about 8 ft is expected at the head of the bay. (Author)
W86-00282

2I. Water In Plants

INTERCEPTION STORAGE CAPACITIES OF TROPICAL RAINFOREST CANOPY TREES,

Boston Coll., Chestnut Hill, MA. Dept. of Geology and Geophysics.
S. R. Herwitz.
Journal of Hydrology, Vol. 77, p 237-252, 1985. 4 Fig, 2 Tab, 27 Ref.

Descriptors: *Interception storage, *Canopy, *Rain forests, *Trees, *Throughfall, Rainwater, Bark, Vegetation, Leaves.

The rainwater interception storage capacities of mature canopy trees in a tropical rainforest site in northeast Queensland, Australia, were approximated using a combination of field and laboratory measurements. The above-ground vegetative surfaces of five selected species (three flaky-barked; two smooth-barked) were saturated under laboratory conditions in order to establish their maximum interception storage capacities. Average leaf surface interception storages ranged from 112 to 161 ml/sq m. The interception storages of bark ranged from 0.51 to 0.97 ml/cu cm. These standardized interception storages were applied to estimates of leaf surface area and bark volume for 51 mature canopy trees representing the selected species in the field site. The average whole tree interception storage capacities of the five species ranged from 110 to 5281 per tree and 2.2 to 8.3 mm per unit projected crown area. The highly significant interspecific differences in interception storage capacity suggest that both floristic and demographic data are needed in order to accurately calculate a forest-wide interception storage capacity for species-rich tropical rainforest vegetation. Species with large woody surface areas and small projected crown areas are capable of storing the greatest depth equivalents of rainwater under heavy rainfall conditions. In the case of both the flaky-barked and the smooth-barked species, bark accounted for > 50% of the total interception storage capacity under still-air conditions, and > 80% under turbulent air conditions. The emphasis in past interception studies on the role of leaf surfaces in determining the interception storage capacity of a vegetative cover must be modified for tropical rainforests to include the storage capacity provided by the bark tissue on canopy trees. (Author's abstract)
W86-00037

IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COMMUNITIES; VOLUME X: INDEX AND ADDENDUM TO VOLUMES I-VIII,

Washington Univ., Seattle. Coll. of Forest Resources.
R. J. Chapman, and T. M. Hinckley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-128132. FWS/OBS-82/23, July 1982. Fish and Wildlife Service, Kearneysville, WV. Eastern Energy and Land Use Team. 110 p, 20 Fig, 6 Tab, 234 Ref, 2 Append. Contract/Grant No. 14-16-0009-953.

Descriptors: *Soil-water-plant relationships, *Vegetation, *Wetlands, *Plant populations, *Water level fluctuations, Ecosystems, Riparian vegetation, Trees, Shrubs, Streams, Flooding, Environmental effects, Aquatic plants, Rivers, Water stress, Drought resistance.

This report provides the user with a summary and a general reference document for Volumes I-VIII of the Fish and Wildlife Service series on Impact of Water Level Changes on Woody Riparian and Wetland Communities. This series reviews and synthesizes existing information on the effects of water level changes on woody plants found in riparian and wetland communities. Such vegetation provides an essential component of habitat for many species of fish and wildlife throughout the United States. This index provides the reader with a summary of the earlier volumes, a list of new literature, excerpts of pertinent recent findings, and a list of errors in preceding volumes. In addition, a section on site rehabilitation has been included. (Author)
W86-00254

IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COMMUNITIES; VOLUME IX: THE ALASKA REGION,

Washington Univ., Seattle. Coll. of Forest Resources.
L. C. Lee, and T. M. Hinckley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-128702. FWS/OBS-82-22, July 1982. Fish and Wildlife Services, Kearneysville, WV. Eastern Energy and Land Use Team. 213 p, 28 Fig, 27 Tab, 156 Ref, Append. Contract/Grant No. 14-16-0009-953.

Descriptors: *Soil-water-plant relationships, *Vegetation, *Wetlands, *Plant populations, *Water level fluctuations, Ecosystems, Riparian vegetation, Trees, Shrubs, Streams, Flooding, Environmental effects, Literature review, Cold regions, Tundra, Bogs, Marshes, Swamps, Aquatic plants, Permafrost, Muskeg, Fens, Arctic, Rivers, Water stress.

Literature on wetland and riparian plant communities in Alaska is reviewed for the purposes of planning and land management. Woody plants, perennial graminoids, and many herbaceous species are included. Detailed species lists are provided for three primary divisions (tundra, subarctic, and marine) and six provinces (Arctic tundra, Brooks Range, Bering tundra, Alaska range, Yukon forest, Pacific forest). A section on species tolerance to inundation is provided. Guidelines pertaining to other ecoregions of the U.S. are not applicable to the Alaska region because of unique conditions of cold temperature, high dissolved oxygen concentrations, low plant demand for oxygen, and nitrogen-deficient soils. The appendix lists all the plants believed to occur in Alaskan wetlands.
W86-00292

2J. Erosion and Sedimentation

TRANSPORT OF SUSPENDED MATERIAL IN OPEN AND SUBMERGED STREAMS,

Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
R. Wiuff.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 774-792, May, 1985. 10 Fig, 1 Tab, 20 Ref, 1 Append.

Descriptors: *Suspended sediments, *Sediment transport, *Mathematical studies, Turbidity currents, Wind-driven currents, Efficiency concept, Energy dissipation.

One of the most useful methods used to establish sediment transport equations is based on the hypothesis that the rate of sediment transport is related to the energy dissipation of the flow. The energy exchange in streams carrying suspended material was analyzed using an efficiency concept. The efficiency is defined as the ratio between the gain in potential energy of the suspended material and the turbulent dissipation. The efficiency is not constant, but depends linearly on Shields' parameter. The linear relation was used to develop a simple formula, which describes the suspended load as a function of well-known parameters. With the results from open streams an auto-suspension criterion was developed for turbidity currents. This criterion describes the situation when a submerged current carrying suspended material neither deposits nor erodes material. A calculated value of the grain size corresponds well with observed values from the turbidity current in Lake Mead. As no constant efficiency is present in open streams as shown in this study, it seems unlikely that this should be the case in more complicated flows such as for wind-driven currents. Because the linear relation between the efficiency and the Shields' parameter cannot easily be extended to wind-driven suspension in lakes, these kinds of phenomena need more sophisticated methods if a satisfactory description of the suspension processes is to be developed. (Collier-IVI)
W86-00013

SEDIMENT TRANSPORT BY IRRIGATION RETURN FLOWS IN FOUR SMALL DRAINS WITHIN THE DID-18 DRAINAGE OF THE SULPHUR CREEK BASIN, YAKIMA COUNTY, WASHINGTON, APRIL 1979 TO OCTOBER 1981,

Geological Survey, Tacoma, WA. Water Resources Div.
P. R. Boucher.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4167, 1984. 149 p, 8 Fig, 14 Tab, 19 Ref.

Descriptors: *Sediment transport, Sediment yield, Sediment discharge, Suspended sediments, *Irrigation practices, Irrigation-return flow, *Water temperature, Sulphur Creek, Yakima County, *Washington, Best Management Practices, Imhoff Cone readings, Suspended sediment concentrations.

Suspended sediment, water discharges, and water temperatures were monitored in four small drains in the DID-18 basin of the Sulphur Creek basin, a tributary to the Yakima River, Washington. Water outflow, inflow, and miscellaneous sites were also monitored. The information was used to evaluate the effectiveness of management practices in reducing sediment loads in irrigated areas. This study was one of seven Model Implementation Plan projects selected by the U.S. Soil Conservation Service and the U.S. Environmental Protection Agency to demonstrate the effectiveness of institutional and administrative implementation of management plans. Sediment discharges from the four basins could not be correlated with changes in management practices, because Imhoff Cone readings collected for the study showed no statistical differences between the three irrigation seasons. However, one drain acted as a sink for sediment where more lands were sprinkler irrigated; this drain had a smaller proportion of row crops than did the other three drains. (USGS)
W86-00112

EVALUATION OF A HYDROGRAPH SHIFTING METHOD FOR ESTIMATING SUSPENDED-SEDIMENT LOADS IN ILLINOIS STREAMS,

Geological Survey, Urbana, IL. Water Resources Div.
R. Frost, Jr., and J. Mansue.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4037, 1984. 37 p, 14 Fig, 5 Tab, 5 Ref.

Descriptors: *Suspended sediments, *Suspended load, *Hydrographs, *Transport equations, *Illinois, Sediment transport.

A hydrograph-shifting method for estimating monthly and annual suspended-sediment loads was applied to suspended-sediment records for 12 streams in Illinois. Transport equations for each station were developed and synthetic sediment-discharge hydrographs were then generated by using these transport equations and records of daily streamflow. Hydrographs were shifted to measured values of daily sediment discharge selected to represent weekly, biweekly, and monthly sampling frequencies. Estimates of monthly suspended-sediment load ranged from 16 to 326 percent of measured values. Estimates of annual sus-

pended-sediment loads ranged from 41 to 136 percent of measured values. (The method provides a reasonable means of estimating annual loads for most sites.) An experiment designed to measure the subjectivity of the method showed it to be more dependent on the particular days selected as control points than on the person applying the method. An evaluation of the effect of the length of record used to develop transport equations was not conclusive. Although standard errors of estimate showed no improvement, the comparison of estimated loads with measured loads showed slight improvement when 1 or 2 years of data were added to the data used to develop transport equations. (USGS)
W86-00115

PRELIMINARY APPRAISAL OF SEDIMENT SOURCES AND TRANSPORT IN KINGS BAY AND VICINITY, GEORGIA AND FLORIDA,

Geological Survey, Doraville, GA. Water Resources Div.
J. B. McConnell, D. B. Radtke, T. W. Hele, and G. R. Buell.
USGS Water-Resources Investigation Report 83-4060, 1983. 68 p, 23 Fig, 15 Tab, 32 Ref.

Descriptors: *Suspended sediment, *Sediment transport, *Estuaries, Velocity, Salinity, Temperature, *Georgia, Camden County, Florida, Nassau County.

Water-quality, bottom-material, suspended-sediment, and current-velocity data were collected during November 1981 in Kings Bay and vicinity to provide information on the sources and transport of estuarine sediments. Kings Bay and Cumberland Sound, the site of the Poseidon Submarine Base in southeast Georgia, are experiencing high rates of sediment deposition and accumulation, which are causing serious navigational and operational problems. Velocity, bathymetry, turbidity, and bottom-material data suggest that the area in the vicinity of lower Kings Bay is accumulating deposits of suspended sediment transported from Cumberland Sound on the floodtide and from upper Kings Bay and the tidal marsh drained by Marianna Creek on the ebbtide. Suspended-sediment discharges computed for consecutive 13-hour ebbtides and floodtides showed that a net quantity of suspended sediment was transported seaward from upper Kings Bay and Marianna Creek. A net landward transport of suspended sediment computed at the St. Marys Entrance indicated areas seaward of St. Marys Entrance may be supplying sediment to the shoaling areas of the estuary, including lower Kings Bay. (USGS)
W86-00125

RUNOFF, SEDIMENT TRANSPORT, AND WATER QUALITY IN A NORTHERN ILLINOIS AGRICULTURAL WATERSHED BEFORE URBAN DEVELOPMENT, 1979-81,

Geological Survey, Urbana, IL. Water Resources Div.
H. E. Allen, Jr., and J. R. Gray.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 82-4073, 1984. 55 p, 15 Fig, 11 Tab, 23 Ref.

Descriptors: *Sediment discharge, *Storm runoff, *Rainfall, *Agricultural runoff, Water pollution sources, Sediment transport, *Sediment yield, *Peak discharge (water), Streamflow, *Agricultural watershed, Erosion, Land use, Water quality, Soil surveys, Particle size, Bedload, Water temperature, Specific conductivity, Dissolved solids, Chemical analysis, Gaging stations, *Illinois, *Upper Spring Creek watershed, Rockford (IL), Storm characteristics, Urban construction, Erosion potential, Land cover.

A study designed to quantify and evaluate changes in runoff and sediment transport attributable to construction activities during urban development of a watershed required identification of pre-construction hydrologic conditions. Data collected before construction on a 2.81 sq m (7.28 sq km) agricultural watershed (upper Spring Creek) near Rockford, IL, show that during a 2-year period ending June 30, 1981, 2,890 tons (2,620 Mg) of suspended sediment were transported from the watershed. Of the 2,890 tons (2,620 Mg), 2,690 tons (2,440 Mg) or 93.1 % were transported during a storm in a 46.6-hour period of June 13-14, 1981. Runoff from a 0.031 sq m (0.080 sq km) subbasin (Spring Creek tributary) transported 33.9 tons (30.9 Mg) of suspended sediment during a 3.2-hour storm period on June 13, 1981. Regression models relating storm suspended-sediment yields and peak-water discharge per square mile for upper Spring Creek and Spring Creek tributary have average standard errors of 57 and 24 %, respectively. Trace amounts of currently banned pesticides, including Aldrin and DDT, were detected in streambed material samples. Documented sediment yields, chemical quality, and relations between runoff and sediment discharge provide baseline information for future evaluation of hydrologic conditions in the watershed. (USGS)
W86-00133

SOURCES, COMPOSITION, AND TRANSPORT OF SUSPENDED PARTICULATE MATTER IN LOWER COOK INLET AND NORTHWESTERN SHELIKOF STRAIT, ALASKA,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. A. Feely, and G. J. Massoth.
NOAA Technical Report ERL 415-PMEL 34, January 1982. 28 p, 17 Fig, 2 Tab, 28 Ref.

Descriptors: *Particulate matter, *Chemical analysis, *Seasonal distribution, *Sediment transport, Suspended load, Salinity, Bays, Estuaries, Cook Inlet, Shelikof Strait, *Alaska, Tides, Currents.

The chemical composition and seasonal distribution of suspended particulate matter collected during 1977 and 1978 in lower Cook Inlet and northwestern Shelikof Strait are compared with published data on current patterns. With respect to suspended-matter dispersal patterns, Cook Inlet shows characteristics of both an estuary and an embayment. Estuarine characteristics are exemplified by the association of the inorganic terrestrial material from upper Cook Inlet with the outward-flowing estuarine water. Plots of total suspended-matter concentrations versus salinity for surface and near-bottom waters are roughly linear for the central region of lower Cook Inlet, indicating that dilution of the estuarine water by relatively non-turbid oceanic water is the major factor controlling suspended-matter concentrations in the inlet. Embayment characteristics are indicated by the cross-channel suspended-matter gradients and by the elemental ratios of the particulate matter, which show evidence for movement of Copper River-derived aluminosilicate material across the mouth of the inlet and into Shelikof Strait. These features, which are unique to lower Cook Inlet, are a direct result of the unusual nature of the current patterns existing within the inlet. (Author)
W86-00150

SUSPENDED PARTICULATE MATTER IN ELLIOTT BAY,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
E. T. Baker.
NOAA Technical Report ERL 417-PMEL 35, March 1982. 44 p, 34 Fig, 7 Tab, 17 Ref.

Descriptors: *Particulate matter, Suspended load, *Suspended solids, *Suspended sediment, Distribution, Sediment transport, Elliott Bay, Puget Sound, Bays, *Washington.

The distribution and transport of suspended particulate matter (SPM) in Elliott Bay, an embayment of Puget Sound, Washington, was compared for dry (August) and wet (February) seasons of 1979-1980. During both survey times, the SPM distribution throughout the bay consisted of 1) a thin (< 5 m) surface layer of variable SPM concentration dominated by phytoplankton growth in summer and Duwamish River runoff in winter, 2) a uniform mid-depth minimum-SPM zone, and 3) a bottom nepheloid layer of concentrations and thickness highly variable in space and time. The total mass of SPM in Elliott Bay was about 20% higher in February (15.7 to the 8th g) than in August (13.0 to the 8th g). Scatter plots of salinity vs. SPM for both seasons indicate a strong negative correlation (r=-.95) in the surface water and a weaker positive correlation (r=.52) in the bottom waters. Vertical and horizontal transport of SPM was measured with sediment traps and current meter/transmissometer deployed at two stations. Accumulation of settled SPM 5 m above the bottom was 16%-30% higher in summer (approximately 34.5 g/sq m/day) than in winter (26.8 g/sq m/day). Organic matter made up 6.9%-12.3% of the trapped sediment. Cross-spectral analysis between near-bottom velocity and SPM concentration showed significant coherency at tidal frequencies. Transport of the SPM was dominated by the mean flow, and diffusion components had little influence. The high positive correlations between SPM and salinity concentrations and low negative correlations between SPM concentrations and current speed imply that advection plays a larger role than resuspension in maintaining the bottom nepheloid layer in Elliott Bay. (Author)
W86-00151

SEDMNT: A SEDIMENT TRANSPORT SUBMODEL BASED ON HYDRODYNAMIC PRINCIPLES FOR THE UNIFIED TRANSPORT MODEL,

Oak Ridge National Lab., TN. Environmental Sciences Div.
D. M. Hetrick, M. R. Patterson, and A. L. Sjoreen.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82008904. ORNL/TM-7831, March 1982. 121 p. 5 Fig, 2 Tab, 11 Ref, 4 Append. Contract/Grant No. W-7405-eng-26.

Descriptors: *Computer programs, *Sedimentation, *Computer models, *Mathematical models, *Sediment transport, Streams, Channel flow, Erosion, Scour.

SEDMNT is a computer code written to model the movement of sediment through a stream channel, and is based on the SEDONE model. The mathematical model of SEDMNT consists of a system of coupled, ordinary differential equations for sediment concentration (by size class) which are solved by the Runge-Kutta-Gill integration scheme. Sediment of selected size classes is resident in the channel bed and enters the channel with stream flow. Transportation, erosion, or deposition of sediment may occur for each size class depending on the amount of sediment present and the stream volume, velocity, and turbulence. Input to the model includes flow data from the calling program (UTM) and initial sediment concentrations provided by the user. Output includes a listing of the input and calculated sediment concentrations for selected time steps. Thorough testing of SEDMNT within the framework of UTM will not be possible until a complete data set is available. SEDONE, the basis of SEDMNT, has been thoroughly tested with data from the Hudson, Mississippi, and Atchafalaya Rivers. This testing was done by running SEDMNT with a stand-alone driving program rather than within UTM. It is possible that additional adjustment of the empirical parameters in SEDMNT will be needed as better test data becomes available. The results obtained from SEDMNT for the Walker Branch Watershed are encouraging. Past success with the SEDONE model implies that SEDMNT can be used to produce useful information on the possible fate of transported sediment.
W86-00155

BUHNE POINT, HUMBOLDT BAY, CALIFORNIA, DESIGN FOR THE PREVENTION OF SHORELINE EROSION: HYDRAULIC AND NUMERICAL MODEL INVESTIGATIONS,

Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 4D.
W86-00169

SHORE STABILIZATION WITH SALT MARSH VEGETATION,
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 8G.
W86-00189

HYDROCARBONS ASSOCIATED WITH SUSPENDED MATTER IN THE GREEN RIVER, WASHINGTON,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 5B.
W86-00196

SAND RESOURCES AND GEOLOGICAL CHARACTER OF LONG ISLAND SOUND,
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 8E.
W86-00205

STREAM CHANNEL STABILITY ASSESSMENT,
Geological Survey, Menlo Park, CA.
J. C. Brice.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118190. Report No. FHWA/RD-82-021, January 1982. Final Report. Federal Highway Administration, Washington, DC. 42 p, 33 Fig, 2 Tab, 44 Ref. Coontract/Grant No. DTFH61-81-P-30085.

Descriptors: *Erosion, *Streams, *Hydraulic structures, *Bridges, *Channel morphology, Streambanks, Channel scour, Scour, Channel erosion, Alluvial channels, Highways, Roads, Unstable channels, Bank, erosion, Stream erosion, Stream banks, Maps, Aerial photography, Photography, Meanders, Braided streams, Degradation, Thalweg.

A simple method for determining relative stability of streams is based on stream morphology. This is useful for planning highway bridges. Channel instability is manifested as lateral bank erosion, progressive streambed degradation, or natural scour and fill of the streambed. Four major stream types are distinguished, based on variability of width and presence of bars: equiwidth, point bar; wide-bend, point bar; braided, point-bar; and braided, no point bars. Measurements of bank erosion on a group of 36 streams show that equiwidth streams have the lowest lateral erosion rates; braided, point bar streams have the highest. Erosion rates increase with stream size. Lateral stability may be measured by field assessment, repetitive surveys of channel cross section, and measurement on air photos and maps. Methods for assessing channel degradation include field studies, changes in elevation of the water surface or channel bottom and hydraulic analysis. The degree of meandering and degree of channel instability are unrelated. Natural scour and fill occurs by three different mechanisms, all relevant to bridge pier depth: bed form migration, convergence of flow, and shift of thalweg or braids within a channel.
W86-00214

DEVELOPMENT OF A NUMERICAL MODELING CAPABILITY FOR THE COMPUTATION OF UNSTEADY FLOW ON THE OHIO RIVER AND ITS MAJOR TRIBUTARIES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2E.
W86-00220

EFFECTS OF BEACH NOURISHMENT ON THE NEARSHORE ENVIRONMENT IN LAKE HURON AT LEXINGTON HARBOR (MICHIGAN),
Coastal Engineering Research Center, Fort Belvoir, VA.
For primary bibliographic entry see Field 6G.
W86-00224

DESIGN FOR PREVENTION OF BEACH EROSION AT PRESQUE ISLE BEACHES, ERIE, PENNSYLVANIA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00257

MATHEMATICAL MODEL, SERATRA, FOR SEDIMENT-CONTAMINANT TRANSPORT IN RIVERS AND ITS APPLICATION TO PESTICIDE TRANSPORT IN FOUR MILE AND WOLF CREEKS IN IOWA.
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 5B.
W86-00259

ANSWERS (AREAL NONPOINT SOURCE WATERSHED ENVIRONMENT RESPONSE SIMULATION) USER'S MANUAL.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W86-00287

2K. Chemical Processes

AVERAGE RAINWATER PH, CONCEPTS OF ATMOSPHERIC ACIDITY, AND BUFFERING IN OPEN SYSTEMS,
Texas Univ. at Austin. Dept. of Environmental Health Engineering.
For primary bibliographic entry see Field 5B.
W86-00001

ANALYSIS AND INTERPRETATION OF DATA OBTAINED IN TESTS OF THE GEOTHERMAL AQUIFER AT KLAMATH FALLS, OREGON,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00107

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF THE MOUNT SIMON-HINCKLEY AQUIFER, SOUTHEAST MINNESOTA,
Geological Survey, St. Paul, MN. Water Resources Div.
R. J. Wolf, J. R. Ruhl, and D. G. Adolphson.
USGS Water-Resources Investigation Report 83-4031, 1983. 2 p, 14 Fig, 3 Tab, 19 Ref.

Descriptors: *Groundwater, *Water quality, *Aquifers, *Maps, Minnesota, Hollandale embayment, Twin Cities basin.

The Mount Simon-Hinckley aquifer comprises a thick sequence of sandstone, siltstone, and shale that underlies southeast Minnesota. It is an important aquifer in the Hollandale embayment and in the populous Twin Cities metropolitan area, where it supplies about 10 percent of the groundwater used. Withdrawals increase significantly north of the Twin Cities basin, but some additional development of water supplies is still possible. Yields to wells are generally about 500 gallons per minute but may be as much as 2,000 gallons per minute locally. Dissolved-solids concentrations are slightly lower than in water from other aquifers in the Hollandale embayment and range from about 100 milligrams per liter in the north to as much as 2,400 milligrams per liter in the south. Dominant water type is calcium magnesium bicarbonate; however, sodium chloride-type water is found at depth. Water from the aquifer locally contains iron and manganese in concentrations greater than 1 milligram per liter. (USGS)
W86-00109

QUALITY OF WATER, QUILLAYUTE RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
M. O. Fretwell.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4162, 1984. 96 p, 24 Fig, 16 Tab, 35 Ref.

Descriptors: *Water quality, *Groundwater, *Surface water, *Estuaries, Quileute Indian Reservation, Quillayute River, *Washington.

Groundwater in Quillayute River basin is generally of the calcium bicarbonate type, although water from some wells is affected by seawater intrusion and is predominantly of the sodium chloride type. The water is generally of excellent quality for most uses. River-water quality was generally excellent, as evaluated against Washington State water-use and water-quality criteria. Fecal coliform concentrations in all major tributaries met State water-quality criteria; water temperatures occasionally exceeded criteria maximum during periods of warm weather and low streamflow. Nutrient concentrations were generally low to very low. The four largest lakes in the basin were temperature-stratified in summer and one had an algal bloom. The Quillayute estuary had salt-wedge mixing characteristics; pollutants entering the salt wedge tended to spread to the toe of the wedge. Upwelling ocean water was the major cause of the low dissolved-oxygen concentrations observed in the estuary; ammonia concentrations in the estuary, however, were increased by the upwelling ocean waters. As in the rivers, total-coliform bacteria concentrations in the estuary were greater than fecal-coliform concentrations, indicating that many of the bacteria were of nonfecal origin and probably originated from soils. (USGS)
W86-00111

INVESTIGATION OF WAIKELE WELL NO. 2401-01, OAHU, HAWAII: PUMPING TEST, WELL LOGS AND WATER QUALITY,
Geological Survey, Honolulu, HI. Water Resources Div.
P. R. Eyre.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 83-4089, 1983. 38 p, 9 Fig, 5 Tab, 6 Ref.

Descriptors: *Groundwater quality, *Irrigation return flow, *Ghyben-Herzberg groundwater lens, *Aquifer testing, Oahu, *Hawaii, Basalt aquifer.

Field tests indicate that an abandoned well (No. 2401-01) near the confluence of Waikele and Kipapa Streams, Oahu, Hawaii, can be reactivated to produce potable water at a rate of 400-500 gallons per minute. Previous tests in 1946 and 1954 indicated that the well tapped the brackish transition zone which inderlies the Ghyben-Herzberg lens of the Pearl Harbor aquifer. Results of this study, based on geologic and geophysical logs of the wall, as well as on pumping test and water-quality data, indicate that the slightly brackish water produced by the well results from brackish irrigation return water. It does not appear that pumping from this well will cause seawater upconing or intrusion. (USGS)
W86-00118

EFFECTS OF ACID RAIN ON SOIL AND WATER,
Connecticut Agricultural Experiment Station, New Haven.
E. C. Krug, and C. R. Frink.
Bulletin 811, November 1983. 45 p, 6 Fig, 7 Tab, 299 Ref.

Descriptors: *Acid rain, *Acidic water, *Acidic soils, *Chemical properties, *Land use, Organic acids, Air pollution, Forest watersheds, Forest soils, Water pollution, Leaching, Aluminum, Reforestation, Water pollution sources.

The impact of acid rain on soil and water can only be judged by placing it in perspective with the natural processes of soil acidification. Most of the natural acidity of rain is due to H2CO3, a weak acid that does not completely dissociate. The acidi-

ty of rain can also be expressed in terms of its ability to neutralize basic substances such as limestone. Man-made inputs are very small when compared with normal agricultural amendments with limestone, or with the tremendous amounts of acidity produced in forest soils on highly siliceous parent material. Acidity in soils is generated by biological decomposition which creates oxides of C, N, and S that react with water to form acids. Because cation exchange reactions are rapid, extra H ions from acid rain could leach nutrient cations from the soil. Despite chemical and biological evidence that acid rain will not enhance leaching of nutrient cations from the acid forest soils of the Northeast, southeastern Canada and Scandinavia, misconceptions about the nature of soil acidity sustain the notion that acid rain is increasing acidification of soil and water. Another misconception is that the rate of acid production in soil is equal to the rate of mineral weathering plus acid export. The largest cause of acidification of lakes and streams is generally the revegetation and reforestation of disturbed land. The degree to which acid rain may be accelerating this process needs to be evaluated on a watershed basis.
W86-00166

DISSOLVED METHANE CONCENTRATIONS IN THE SOUTHEAST BERING SEA, 1980 AND 1981,

Science and Education Administration, Fort Lauderdale, FL. Aquatic Plant Management Lab.
C. N. Katz, J. D. Cline, and K. Kelly-Hansen.
NOAA Data Report ERL PMEL-6, July 1982. 194 p, 4 Ref, 3 Append.

Descriptors: *Methane, *Water Quality, Water chemistry, *Data collections, *Chemical analysis, Salinity, Solubility, *Bering Sea.

Dissolved methane was measured in the southeastern Bering Sea as a part of the Outer Continental Shelf Environment Assessment Program, administered by the National Oceanic and Atmospheric Administration. Methane analysis was routinely done in the field using a purge and trap technique, followed by quantitation on a Hewlett-Packard 5710 A gas chromatograph. The data presented are organized in a hierarchy of cruise (chronological order), station and depth distribution. Station data include: station number, latitude and longitude to the nearest tenth of a degree; local data and time of sampling, Greenwich Mean Time zone, and depth to the bottom in meters. Depth information includes: depth of the sample in meters, water temperature in degrees centigrade, salinity in grams per kilogram, sigma-t, dissolved methane concentration in nanoliters of methane gas per liter seawater corrected to standard temperature and pressure (STP), dissolved methane equilibrium solubility, and the methane solubility ratio (C/C*), which is the ratio of the observed methane concentration to the equilibrium solubility methane concentration.
W86-00180

KARNES COUNTY, TEXAS, AREA HYDROCHEMICAL AND STREAM URANIUM ORIENTATION STUDY,

Du Pont de Nemours (E.I.) and Co., Aiken, SC. Savannah River Lab.
K. F. Steele.
National Uranium Resource Evaluation Program, Report No. DPST-81-141-18, April 1982. 14 p, 1 Fig, 6 Tab, 5 Ref. Contract/Grant No. DE-AC09-76SR00001.

Descriptors: *Geochemistry, *Uranium, *Groundwater, *Water analysis, Wells, Mineral industry, Water pollution sources, Fate of pollutants, Karnes County, Texas, Surface water, Sediments, Bed sediments, Suspended sediments.

Groundwater sampling may be an effective method of sampling for uranium deposits in South Texas. Stream and groundwater samples were collected over and near known uranium deposits. The stream water quality parameters were more constant than the groundwater parameters. For example, pH was 7.5-8.5 in surface water, 6.2-9.1 in groundwater; conductivity was 1100-2300 micromhos/cm in surface water, 54-8900 micromhos/cm in groundwater; uranium, < 4 to 25 parts per billion in surface water, about 2 parts per million in stream sediment, and < 4 to 66 parts per billion in groundwater. Samples with high uranium levels were collected in wells penetrating known ore zones. Sulfate levels were also high in high-uranium samples.
W86-00194

2L. Estuaries

TRACER APPLICATIONS OF ULTRA-VIOLET ABSORPTION MEASUREMENTS IN COASTAL WATERS,

University Coll. of North Wales, Menai Bridge. Marine Science Labs.
P. Foster.
Water Research, Vol. 19, No. 6, p 701-706, 1985. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Environmental tracers, *Ultraviolet absorption, *Coastal waters, *Absorption, Radiation, Tracers, Organic compounds, Inorganic compounds, Nitrates, Bromides.

The ultra-violet absorption properties of natural waters may be used as a tracer for following the distribution of source waters in coastal water systems. Measurements can be made readily upon sample collection and filtration on board ship. The form of the spectrum can be considered as two distinct sections: within the spectral region 250-350 nm modifications of the UV absorption are direct manifestations of changes in the concentration and/or nature of the dissolved organic matter; below 250 nm inorganic species, such as nitrate and bromide, in addition to the dissolved organic matter, contribute to the absorption. UV data was collected during two winter cruises off the west coast of Great Britain. Four absorption indices were developed as being of potential tracer value to mixing studies in coastal waters. The intensity factor in the organic region of the spectrum was numerically evaluated as the integrated absorption (Sigma A) between 250 and 350 nm, while the magnitude of the absorption at 225 nm (A225) was adopted as the intensity factor for the composite region. The organic and composite shape factors were evaluated as the absorption ratios, A250/A275 and A225/A250, respectively. In March salinity was highly correlated with Sigma A. Offshore waters were characterized by high salinities and low values of Sigma A. Coastal waters of low salinity and high Sigma A formed the other end member and in contrast to the analogous mixing diagram for December there was no clear distinction between bay and coastal waters with respect to their Sigma A loading. The relationship which best met the tracer criterion of a low correlation coefficient was that between salinity and the intensity factor A225; this relationship provided a very effective separation of three water types. A marked temporal change in the absorption characteristics was associated the waters in particular areas. As a consequence, the most effective combination of tracer indices at one time of year may not necessarily be the most effective combination at another. (Collier-IVI)
W86-00056

EFFECTS OF SPATIAL VARIATION IN AMPLITUDE AND PHASE OF THE OSCILLATORY TIDAL CURRENTS ON THE RESIDUAL LAGRANGIAN DRIFTS,

Delaware Univ., Newark. Coll. of Marine Studies.
K.-C. Wong.
Water Resources Research, Vol. 21, No. 5, p 769-774, May, 1985. 6 Fig, 5 Ref.

Descriptors: *Tidal currents, *Estuarine environment, *Lagrangian circulation, Circulation, Water currents, Tidal waters, Spatial distribution, Velocity.

The understanding of the characteristics of residual Lagrangian circulation in estuaries is important, since the transport of dissolved or suspended material is a Lagrangian phenomenon. The basic behaviors of residual Lagrangian drifts under the influence of oscillatory tidal currents with spatial variations in amplitude and phase are examined analytically for relatively simple Eulerian velocity fields. Intense residual Lagrangian drifts are generated by strong spatial velocity gradients and the residual drifts at any given location are heavily dependent on the initial release time relative to the phase of the tidal current. A relatively weak mean flow can interact with the tidal currents and produce significant modification of the residual drifts as well as their dependency on the initial conditions. Both the magnitude and the direction of the mean flow are important in affecting the dependency of the residual drift estimates on the initial conditions. The presence of strong spatial variation in tidal current may render the approximation of some equations invalid so estimation of residual Lagrangian drifts based on limited Eulerian measurements will lead to large errors under these circumstances. Strong spatial gradients in tidal currents are able to induce intense residual Lagrangian drifts and these residual drifts depend strongly on the release time relative to the phase for the tidal currents. Given a tidal current field with strong spatial gradients, a relatively weak mean flow can modify the residual drifts as well as their dependency on the initial conditions significantly. The mean flow direction is very important to the residual drift estimates. (Baker-IVI)
W86-00085

CIRCULATION IN THE LOWER COOK INLET, ALASKA,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
R. D. Muench, J. D. Schumacher, and C. A. Pearson.
NOAA Technical Memorandum ERL PMEL-28, July 1981. 26 p, 10 Fig, 2 Tab, 32 Ref.

Descriptors: *Water currents, *Tidal currents, *Flow rates, Ocean currents, Flow pattern, Flow, Cook Inlet, Shelikof Strait.

Circulation in the lower Cook Inlet region has been described and discussed utilizing current observations obtained during October 1977-October 1978. The major circulation feature was a mean westerly flow which entered the region via Kennedy and Stevenson entrances, parallels the 100-m isobath through the lower Inlet, then exits the system via Shelikof Strait. Summer mean current speeds in this flow were 10-15 cm/s. Winter speeds were 25-30 cm/s. A secondary circulation feature was present as a southward flow which occupied the western portion of the lower Inlet. Summer current speeds here were 15-20 cm/s, while winter speeds were of order 10 cm/s. The westerly flow is driven in summer primarily by a baroclinic field consequent to coastal freshwater input (the Kenai Current), while in winter this flow is driven to a greater extent by wind-driven coastal convergence and possibly by an alongshore pressure gradient set up by the Alaskan Stream. The southward flow, driven by freshwater input into upper Cook Inlet, therefore is larger in summer when this input is greater. Mean flow in the eastern lower Inlet was weak and variable in all seasons. Low-frequency and tidal flow fluctuations were superimposed upon the mean flow, and in regions of low mean speeds, controlled the instantaneous flow. The low-frequency fluctuations were associated with westerly flow through the system. Tidal currents were large (70-100 cm/s) and primarily semidiurnal in the eastern portion of the the lower Inlet and in the Kennedy and Stevenson entrances. In the western Inlet, tidal currents were only half this magnitude, and in Shelikof Strait they were very small due to the presence of an antinode near the mooring in northern Shelikof Strait. Tidal currents were aligned with the local channel bathymetry. (Author)
W86-00149

SOURCES, COMPOSITION, AND TRANSPORT OF SUSPENDED PARTICULATE MATTER IN LOWER COOK INLET AND NORTHWESTERN SHELIKOF STRAIT, ALASKA,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2J.
W86-00150

SUSPENDED PARTICULATE MATTER IN ELLIOTT BAY,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2J.
W86-00151

ATCHAFALAYA RIVER DELTA; REPORT 9: WIND CLIMATOLOGY,
Coastal Engineering Research Center, Vicksburg, MS.
B. A. Ebersole.
Technical Report HL-82-15, January 1985. Report 9 of a Series. 122 p, 57 Fig, 44 Tab, 6 Ref.

Descriptors: *Climatology, *Hydrodynamics, *Wind, *Weather patterns, *Bays, Wind velocity, Meteorological data collection, Seasonal variation, Model studies, Statistical analysis, Weather data collections.

Data on the wind climate typical of the Atchafalaya Bay area were gathered from October 1981 to October 1982. These data along with data from National Weather Service stations were statistically analyzed to give estimates of wind speed and direction. These statistics were then related to the different kinds of weather patterns that affect this region by categorizing these patterns into seven all-inclusive types with each defined by a particular set of dynamical characteristics. Data was provided on the frequency of occurrence of wind conditions both with and without regard to their causative factors. The latter results were used to substantiate results obtained using the statistical-climatological approach. The long-term historical data gave information on extreme wind conditions that can be expected to occur in any given year. This data can be used to better understand physical processes within the bay that are strongly dependent on local wind conditions such as hydrodynamic circulation patterns, flooding and drying of marshes, dispersion and disposition of sediments, dispersion of any pollutants, and distribution of fresh and salt water.
W86-00163

CURRENT MEASUREMENTS IN THE COLUMBIA RIVER ESTUARY,
Chalmers Univ. of Technology, Goeteborg (Sweden). Institutionen foer Kaernkemi.
M. R. Mulhern.
Master of Science, Report. University of Washington, Seattle. 1982. 60 p, 10 Fig, 2 Tab, 16 Ref, 1 Append.

Descriptors: *Water currents, *Computer programs, Tidal currents, Estuaries, Current meters, Columbia River.

The principal product of this study was the development and analysis of contour plots of mean phase difference and velocity ratios, at the Columbia River entrance. Surface and subsurface currents were monitored by drifter buoys and subsurface current meters respectively in September 1981. Analog plots of the field data were scanned visually, and smoothed to eliminate high-frequency noise. A computer data base was produced containing flow information sorted by current meter depth, and type of event (slack, flood or ebb). A series of computer programs were written to process the data and generate composite views of mean phase difference and velocity ratios, as compared to predicted tidal currents.
W86-00181

NORFOLK HARBOR AND CHANNELS DEEPENING STUDY, REPORT 1: PHYSICAL MODEL RESULTS, CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. R. Richards, and M. R. Morton.
Technical Report HL-83-13, June 1983. Final Report. 371 p, 29 Fig, 14 Tab, 236 Plates, 9 Ref.

Descriptors: *Estuaries, *Saline water intrusion, *Channel improvement, *Water currents, *Tidal effects, Shallow water, Salinity currents, Navigation, Model studies, Hydraulic models, Norfolk Harbor, Chesapeake Bay, Tidal currents, Neap tides, Spring tides, Stratification, Harbors.

A physical model was use to study the impact of deepening the approach channels to Norfolk and Newport News, Virginia, in the Chesapeake Bay. Steady-state tests were designed to determine the tide and current velocity effects. The dynamic tests were used to study salinity redistribution. The salinity study showed the following: neap-spring variations (as great as 5-8 ppt) in salinity stratification, an increase in salinity intrusion normally confined to deep water areas (shallow water only slightly affected), redistribution of salt within the cross section of channels with adjacent shallow water (salinity increase in channel and decrease in shallow water), and net increase in depth-averaged salt with an increase in stratification. On the average, changes in salinity were less than 2 ppt.
W86-00266

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

HIGH-TEMPERATURE DESALINATION CAPABILITY OF TFC 1501 REVERSE OSMOSIS ELEMENT,
Army Mobility Equipment Research and Development Command, Fort Belvoir, VA.
H. H. Goto.
Available from the National Technical Information Service, Springfield, VA 22161 as AD1A121059. Report 2367, July 1982. 36 p, 7 Fig, 4 Tab, Append.

Descriptors: *Desalination apparatus, *Reverse osmosis, Membrane processes, Water treatment, Saline water.

The desalination capability of spiral-wound thin-film composite reverse osmosis elements (TFC 1501) was determined at temperatures up to 132 F, higher than the 113 F specified by the manufacturer. The elements were not degraded in desalinizing capability following exposure for 400 hours to feedwater at about 130 F. The production rate of the elements dropped less than 5% under the following conditions: 400 hours at 130 F and 200 hours at 130 F and high pressure (600 lb per sq in). The drop in production rate can be compensated for by operation at higher pressure, 1000 lb per sq in. Some telescoping of the elements occurred during high-temperature operation, but performance characteristics were not degraded.
W86-00265

3B. Water Yield Improvement

RAINWATER CATCHMENT WATER QUALITY IN MICRONESIA,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
T. A. Dillaha, III, and W. J. Zolan.
Water Research, Vol. 19, No. 6, p 741-746, 1985. 1 Fig, 3 Tab, 18 Ref.

Descriptors: *Rainwater catchment systems, *Domestic water, *Micronesia, *Water quality, Bacteria, Cisterns, Potable water, Water supply, Coliforms.

Rainwater catchment systems (RWCS) in Micronesia were sampled to assess their bacteriological water quality and to determine which RWCS characteristics had a significant impact on water quality. Total and fecal coliform bacteria tests were used to evaluate 203 catchments on 10 islands. Fifty-seven percent of the RWCS had no fecal coliform bacteria and 61% had fewer than 10 total coliform bacteria per 100 ml. Catchment characteristics were found to have a statistically significant effect on total coliform bacteria levels but they did not affect fecal coliform bacteria concentrations. Rainwater catchment systems were found to provide acceptable water in most cases but disinfection prior to consumption is still highly recommended. (Author's abstract)
W86-00061

CLOUD PHYSICS STUDIES IN THE SCPP: INTERIM PROGRESS REPORT, 1983-84.
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
December 29, 1984. 123 p. Contract/Grant No. 2-07-81-V0256.

Descriptors: *Precipitation, *Weather modification, *Cloud seeding, Cloud physics, Orographic precipitation, Sierra Cooperative Pilot Project, Ice.

Several articles report some of the scientific contributions to the Sierra Cooperative Pilot Project. The shallow orographic cloud which remains on the Sierra barrier following passage of upper level hyperbaroclinic zones and katabatic fronts usually contains a substantial amount of supercooled water. The seedability of this cloud will be investigated. In a seeding experiment with dry ice, seeding effects were observed. Combined hydrometeor distributions from three PMS probes were described. In the ice multiplication region centered at -5 degrees C, the combined data are superexponential distributed so that they fit a straight line on a log-log plot. The remaining articles are reprints of referred articles and conference papers.
W86-00305

STRUCTURE OF COLD FRONTS OVER CALIFORNIA,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
J. D. Marwitz.
In: Cloud Physics Studies in the SCPP: Interim Progress Report, 1983-84, December 29, 1984. p 1-28, 8 Fig, 12 Ref.

Descriptors: *Precipitation, *Weather modification, *Cloud seeding, Cloud physics, Katabatic frontal theory, California, Fronts, Sierra Nevadas.

The structure of cold fronts as they move over the Sierra barrier of California are described. The structure of the katabatic front on February 12, 1983, is presented including the kinematic structure as revealed by the serial rawinsondes at Sheridan, California, and the precipitation process as revealed by King Air cloud physics data. These katabatic fronts may represent significant seeding potential.
W86-00306

RESPONSES TO SEEDING CLOUDS WITH DRY ICE IN THE SCPP-1 EXPERIMENT,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
A. R. Rodi.
IN: Cloud Physics Studies in the SCPP: Interim Progress Report, 1983-84, December 29, 1984. p 29-52, 14 Fig, 1 Ref.

Descriptors: *Weather modification, *Precipitation, *Cloud seeding, Orographic precipitation, Cloud physics, Sierra Cooperative Pilot Project, Ice, Dry ice.

Three case studies of treatment of convective clouds were presented. The two cases on March 15, 1984, were probably unseeded. This conclusion is based on the overwhelming body of physical evidence in which no seeding signature was found. The proximity of the seeding to natural echoes (even downwind of them) was not intentional in these cases. The lack of growth of the secon cloud was probably the result of the presence o

these large natural cells. The two clouds, studied within the three-hour experiment, were very different in properties as indicated by the response variables presented. The first cloud, while having more initial ice present, persisted longer and had a much larger quantity of precipitation at 18 min than the second cloud. Both clouds, however, were clearly not in the formation region upwind of naturally occurring echoes as prescribed in the design document. The intentional seeding of the large convective cell on February 24 1984, while producing a microphysical seeding signature, demonstrates the problems which are introduced by seeding convective clouds in proximity of other echoes. While this did not show that the cloud was not seedable, at no time did the seeded region reach the reflectivities equivalent to the natural echoes on nearby storms. In the future, more vigilance is required on the part of both the aircraft and radar crews to avoid such anomalies. The results of these three analyses are evidence that the technology for seeding and studying single convective clouds is established. (Author)
W86-00307

3D. Conservation In Domestic and Municipal Use

MUNICIPAL WATER DEMANDS,
Johns Hopkins Univ., Baltimore, MD. Dept. of Applied Economics.
For primary bibliographic entry see Field 6D.
W86-00275

3E. Conservation In Industry

INDUSTRIAL WATER DEMANDS,
Operational Economics, Inc., Houston, TX.
For primary bibliographic entry see Field 6D.
W86-00273

3F. Conservation In Agriculture

SEDIMENT TRANSPORT BY IRRIGATION RETURN FLOWS IN FOUR SMALL DRAINS WITHIN THE DID-18 DRAINAGE OF THE SULPHUR CREEK BASIN, YAKIMA COUNTY, WASHINGTON, APRIL 1979 TO OCTOBER 1981,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-00112

AGRICULTURAL WATER DEMANDS,
For primary bibliographic entry see Field 6D.
W86-00274

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ADVANCEMENT IN HYDRAULIC MODELING OF POROUS PAVEMENT FACILITIES,
Espey, Huston and Associates, Inc., Austin, TX.
For primary bibliographic entry see Field 2E.
W86-00098

PLANNING AND IMPLEMENTATION OF REGIONAL STORMWATER MANAGEMENT FACILITIES IN MONTGOMERY COUNTY, MARYLAND,
Greenhorne and O'Mara, Inc., Riverdale, MD.
J. M. Crouse, V. H. Berg, and L. J. Mitchell.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 255-271, 3 Fig, 4 Tab.

Descriptors: *Watershed management, *Model studies, *Runoff, *Storm runoff, *Erosion control, *Land development, *Urbanization, *Water quality management, Land use, Urban watersheds, Models, Sedimentation, Stream degradation, Storm water, Urban runoff, Detention reservoirs.

Increased flooding, accelerated channel erosion, and reduced water quality of streams in Montgomery County, Maryland due to urbanization and land development has led to the enactment of legislation requiring sediment control during land development. In 1971 the Montgomery Soil Conservation District (MSCD) adopted a stormwater management (SWM) policy requiring the detention of stormwater runoff from the 2-yr storm event on each development site. In 1973 control was mandated by the County's Department of Environmental Protection on a watershed basis. The remedial focus of the County SWM program includes projects to correct existing problems caused by uncontrolled runoff from previously developed areas as well as preventive programs to study the effects of proposed land use plans and their effects on stormflow throughout the watershed. In 1980 a stormwater management ordinance was enacted which relies heavily on the use of centralized SWM facilities which may serve a number of developments. The Cabin Branch study represents one of several case studies being conducted by the County to assess the effects of SWM on subwatersheds. Computerized hydrologic modeling was used to project peak discharges for various development and land use scenarios. Results of these studies indicate that three SWM facilities should be designed and constructed in the Cabin Branch Watershed at specific sites.
W86-00099

TIME-OF-TRAVEL DATA FOR NEBRASKA STREAMS, 1968 TO 1977,
Geological Survey, Lincoln, NE. Water Resources Div.
For primary bibliographic entry see Field 2E.
W86-00120

IMPROVING TECHNOLOGY FOR CHEMICAL CONTROL OF AQUATIC PLANTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
K. K. Steward.
Miscellaneous Paper A-82-4, August 1982. Annual Report for FY 1980. Army Engineer Waterways Experiment Station, Vicksburg, MS. 51 p, 13 Fig, 15 Tab, 8 Ref, Append.

Descriptors: *Aquatic weed control, *Herbicides, *Weed control, 2,4-D, Water hyacinth, Hydrilla, Watermilfoil, Duckweed, Southern naiad, Fenac, Dichlobenil, Pesticides, Cabomba, Water lettuce, Polymers.

Several chemical aquatic weed control techniques were evaluated using a newly developed standard protocol. The release of 2,4-D from the MOE/GMA copolymer (2-methacryloyloxyethyl 2,4-dichlorophenoxyacetate glycerylmethacrylate) in flowing water following an initial application rate of 0.01 to 0.25 mg per liter was linear over 70 days. The compound was effectively phytotoxic to Eurasian watermilfoil for about 4 mo. A dichlobenil-beeswax controlled-released system produced rapid and inconsistent release of the herbicide. Two of three controlled-release fenac formulations were effective against hydrilla at 1.0 mg per liter in 10 wk and against Southern naiad at 1.0 mg per liter in about 8 wk. Cabomba was not controlled. Eurasian watermilfoil was controlled in 16 wk at 0.5 mg per liter. A coded compound (R0-3-7042) was effective against hydrilla over 16 wk at 1.0 mg per liter treatment rate and against Southern naiad in about 8 wk at 5.0 mg per liter. It was very effective against water lettuce at 1.0 mg per liter; marginally effective against water hyacinth; and ineffective against duckweed and cabomba. A growth retardant (EL-507) controlled water hyacinth at 1.0 kg per hectare.
W86-00183

PROCEEDINGS, 16TH ANNUAL MEETING, AQUATIC PLANT CONTROL RESEARCH PLANNING AND OPERATIONS REVIEW.
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
November 17-19, 1981, St. Paul, Minnesota. Miscellaneous Paper A-82-3, June 1982. Final Report. 277 p.

Descriptors: *Weed control, *Aquatic weeds, *Biocontrol, *Herbicides, Aquatic plants, Water hyacinth, Watermilfoil, Hydrilla, Insects, Aquatic insects, Lake Conway, Florida, Fish, White amur, Grass carp, Ecological effects, 2,4-D, Pesticides, Model studies, Fate of pollutants, Wildlife, Parapoynx, Sameodes, Microorganisms, Pathogens, Dredging, HARVEST model, Mechanical control.

Mechanical, chemical, and biological control of aquatic weeds is included in this collection of research papers and weed control activities in regional districts of the Army Engineers. The Limnos mechanical harvesting system improved vertical water mixing and did not significantly decrease dissolved oxygen levels after harvest. The HARVEST mathematical model proved useful in evaluating effects of equipment and environmental conditions on harvesting. Chemical control methods included controlled-release 2,4-D formulations, structural investigation of a naturally occurring hydrilla inhibitor, and the fate of 2,4-D in water, sediment, and fish. Several biological controls proved potentially effective as weed control agents: Parapoynx (an aquatic moth), Sameodes albiguttalis, a variety of insects collected on overseas trips, and microorganisms. A method for surveying aquatic plants on a large scale was demonstrated in the Galveston, Texas, district. Application of endothall to watermilfoil and hydrilla proved most effective in spring. Large-scale operations management of aquatic weeds with white amur was studied in Lake Conway, Florida. The fish population controlled aquatic vegetation without major detrimental effects on native vertebrates or invertebrates. However, desirable vegetation was also eaten. The diver-operated dredge proved efficient for removing small populations of watermilfoil with little fragmentation.
W86-00192

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM PLANTS: SELECTED LIFE HISTORY INFORMATION OF ANIMAL SPECIES ON LAKE CONWAY, FL,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
N. J. Zittleman, R. R. Williams, and E. G. Buglewicz.
Miscellaneous Paper A-82-5, August 1982. Final Report. 101 p, 16 Ref, 3 Append.

Descriptors: *Lakes, *Weed control, *Baseline studies, *Habitats, *Animals, Aquatic animals, Lake Conway, Florida, White amur, Grass carp, Fish, Aquatic weeds, Aquatic habitats, Birds, Fish, Mammals, Amphibians, Reptiles, Food habits, Nesting, Ecology, Biocontrol, Environmental effects, Fish management.

A baseline study of the animal species in Lake Conway, Florida, lists 180 species sighted or collected during January 1976 through September 1977. This is an early activity in the large-scale management test to document the effects of the introduction of the white amur fish for controlling aquatic weeds. Appendix A is a species list with scientific names for 35 fish, 54 birds, 7 mammals, and 28 herpetofauna. Appendix B describes the life history and managment information for each of the species. Appendix C concerns feeding, resting, and reproduction or nesting habitat requirements for the animals. In this list appear several categories with the numbers of the species fitting the category. For example, under food preferences of herpetofauna, 20 types of food are listed with the animal species that use each type.
W86-00197

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control Of Water On The Surface

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS: THE HERPETOFAUNA OF LAKE CONWAY, SPECIES ACCOUNTS,
University of South Florida, Tampa. Dept. of Biology.
For primary bibliographic entry see Field 6G.
W86-00202

2,4-D THRESHOLD CONCENTRATIONS FOR CONTROL OF EURASIAN WATERMILFOIL AND SAGO PONDWEED,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
J. F. Hall, H. E. Westerdahl, R. E. Hoeppel, and L. Williams.
Technical Report A-82-6, December 1982. Final Report. 20 p, 6 Fig, 3 Tab, 12 Ref.

Descriptors: *Weed control, *Aquatic weed control, *Herbicides, Aquatic plants, 2,4-D, Macrophytes, Watermilfoil, Pondweed, Diluter system.

The objective of this study was to use a modified diluter system to determine the minimum sustained (threshold) concentrations of 2,4-dichlorophenoxy acetic acid (2,4-D) required to control the growth of Eurasian watermilfoil (Myriophyllum spicatum L.) and Sago pondweed (Potamogeton pectinatus L.). This study was designed to incorporate recommended improvements and to verify results from a previous pilot study. The diluter system delivered five different concentrations of 2,4-D to five sets of four test aquaria. Another set of four reference aquaria received only tap water. Each aquarium contained meristematic cuttings of M. spicatum and germinated tubers of P. pectinatus planted in beakers containing a standard hydrosoil. Plant injury was assessed after 11 weeks of continuous exposure to the various 2,4-D concentrations. Based on the results of this study, the 2,4-D threshold concentrations required to control M. spicatum and P. pectinatus were determined to be 0.05 to 0.10 mg per liter and 0.10 to 0.25 mg per liter, respectively. This coincided with previous results obtained from a 6-week pilot study. (Author)
W86-00208

MISSION BAY HARBOR, CALIFORNIA, DESIGN FOR WAVE AND SURGE PROTECTION AND FLOOD CONTROL: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00255

4B. Groundwater Management

USES OF RECHARGE WELLS IN WATER SUPPLY,
Keuringsinstituut voor Waterleidingartikelen, Rijswijk (Netherlands).
J. H. Peters.
Journal of the American Water Works Association, Vol. 77, No. 5, p 47-51, 16 Fig, 16 Ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Water supply development, *Wells, Infiltration, Recharge wells, Groundwater flow, Computer models.

Recharge wells, wells by means of which a liquid can be put into the ground have many applications in the field of water supply. Recharge wells can be used for compensating locally for the drawdown of the water table or groundwater head, for regulating the flow of contaminated or salt groundwater, for limiting the catchment and protection zone of a groundwater pumping station and in the technique known as artificial recharge. With a system of recharge and pumping wells it is possible to reduce fluctuations in water quality. Hydrological aspects of three applications of recharge wells were studied using imaginary models, and computer models used to study the flow of groundwater were examined. The potential of recharge wells is not confined to the alternative they offer to open infiltration. Infiltrating pretreated surface water into the ground limits the impact of groundwater withdrawal on the environment and of the environment on groundwater withdrawal. (Baker-IVI)
W86-00006

WATER RESOURCES ON THE PUEBLO OF LAGUNA, WEST-CENTRAL NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00108

GROUND-WATER RESOURCES OF AUDRAIN COUNTY, MISSOURI,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00113

GROUND-WATER CONDITIONS IN THE COTTONWOOD-WEST OAKLEY FAN AREA, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00117

AVAILABILITY OF WATER FROM THE ALLUVIAL AQUIFER IN PART OF THE GREEN RIVER VALLEY, KING COUNTY, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W86-00126

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00129

4C. Effects On Water Of Man's Non-Water Activities

HISTORICAL CHANGES TO LAKE WASHINGTON AND ROUTE OF THE LAKE WASHINGTON SHIP CANAL, KING COUNTY, WASHINGTON,
Geological Survey, Seattle, WA. Water Resources Div.
For primary bibliographic entry see Field 2H.
W86-00105

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, 1978-JULY, 1981: CITATIONS FROM THE NTIS DATA BASE.
National Technical Information Service, Springfield, VA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-801357.
December 1982. 271 p.

Descriptors: *Bibliographies, *Oil shale, *Industrial wastes, *Mine wastes, *Wastewater treatment, *Water pollution control, *Water quality control, Gasification, Pollutant identification, Leachates, Shales, Environmental effects, Ecological effects, Groundwater pollution, Streams, Aquifers, Water requirements.

This bibliography contains 366 abstracts of government-funded research on oil shale. Among the water-related subjects are water pollution control, waste and wastewater characterization and treatment, leachates, effect on groundwater and stream-water quality, health hazards, revegetation of disturbed soils, groundwater monitoring, environmental and ecological impacts, geochemistry, social and economic impacts, hydraulic fracturing, hydrologic aspects, and water consumption.
W86-00201

4D. Watershed Protection

EVALUATION OF A HYDROGRAPH SHIFTING METHOD FOR ESTIMATING SUSPENDED-SEDIMENT LOADS IN ILLINOIS STREAMS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-00115

EVALUATION OF HYDROLOGIC PROCESSES AFFECTING SOIL MOVEMENT IN THE HAGERMAN FAUNA AREA, HAGERMAN, IDAHO,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 2G.
W86-00119

BUHNE POINT, HUMBOLDT BAY, CALIFORNIA, DESIGN FOR THE PREVENTION OF SHORELINE EROSION: HYDRAULIC AND NUMERICAL MODEL INVESTIGATIONS,
Coastal Engineering Research Center, Vicksburg, MS.
R. R. Bottin, and J. A. Earickson.
Technical Report CERC-84-5, November 1984. Final Report. 336 p, 14 Fig, 17 Tab, 142 Photos, 78 Plates, 26 Ref, 2 Append.

Descriptors: *Model studies, *Erosion control, *Beach erosion, *Structural models, *Hydraulic models, Channel erosion, Design criteria, Models, Numerical analysis, Jetties, Sediment transport, Breakwaters.

Two numerical and two physical models were used to study the effects of proposed improvement plans to rectify shoreline erosion at Buhne Point, Humboldt Bay. The numerical tidal circulation model showed that changes in tidal current velocities and flow patterns will be minimal due to proposed improvements. The numerical sediment transport model (CELC3D) showed that no new sediment transport patterns are induced by the optimum improvement plan. The 1:100-scale physical model of central Humboldt Bay showed that, regardless of the incident wave approach from the Pacific Ocean, the angle of the wave front in the vicinity of Buhne Point remains essentially the same. This same model also indicated that test waves directly up the axis of the channel result in significantly larger wave heights in the vicinity of Buhne Point. The 1:50-scale physical model of Buhne Point was used to determine the cause of erosion at the point and the effectiveness of the various structures proposed for protection. Results showed that wave energy approaching the point from the jettied entrance to the bay eroded the original spit. Sediment eroded from the eastern part of the shoal and migrated westwardly where it entered the navigation channel. A reverse curve in the shore-connected breakwater where it originates from the existing Buhne Drive revetment (optimum plan) minimized wave convergence and runup in this area.
W86-00169

ANSWERS (AREAL NONPOINT SOURCE WATERSHED ENVIRONMENT RESPONSE SIMULATION) USER'S MANUAL.
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-115436.
EPA-905/9-82-001, December 1981. Environmental Protection Agency, Chicago, IL. Great Lakes National Program Office. 54 p, 16 Fig, 3 Tab, 26 Ref, 4 Append. Contract/Grant No. EPA-G005335.

Descriptors: *Fate of pollutants, *Erosion control, *Watershed *Soil conservation, *Model studies, management, *Nonpoint pollution sources, Agricultural watersheds, Mathematical models, ANSWERS model, Sediment transport, Hydrology, Land use, Sedimentation, Rainfall rate, Infiltration, Conservation.

This report is an expanded and edited version of the Users Manual for the ANSWERS (Areal Nonpoint Source Watershed Environment Response Simulation) model, first published in September, 1980. ANSWERS is a distributed parameter model capable of predicting the hydrologic and erosion response of primarily agricultural watersheds. Particle-size distributions of the eroded sediment (at all points in the watershed, as well as the outlet) are available. The manual provides insights into model concepts, input requirements, output interpretation, and planning applications. (Author)
W86-00287

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

ANALYSIS OF PHENOLS BY CHEMICAL DERIVATIZATION. IV. RAPID AND SENSITIVE METHOD FOR ANALYSIS OF 21 CHLOROPHENOLS BY IMPROVED CHLOROACETYLATION PROCEDURE,

Canada Centre for Inland Waters, Burlington (Ontario).
H.-B. Lee, R. L. Hong-You, and A. S. Y. Chau.
Journal of the Association of Official Analytical Chemists, Vol. 68, No. 3, p 422-426, 1985. 3 Fig, 2 Tab, 22 Ref.

Descriptors: *Phenols, *Chlorophenols, *Chloroacetylation, *Water analysis, Chloracetic anhydride, Chemical analysis, Organic compounds, Gas chromatography, Chlorinated hydrocarbons.

A quantitative, rapid, sensitive, and isomer-specific method for the analysis of chlorophenols in natural water by in situ chloroacetylation was developed. Without pre-extraction, phenols in water are chloroacetylated by chloroacetic anhydride in the presence of K2CO3. Because of differences in reaction kinetics and stability, various chloroacetates were removed from the reaction mixture at different intervals. A more elaborate procedure was developed for cases where analysis of other classes of neutral organic compounds is also required; the procedure involves solvent extraction of organic compounds and back-extraction of phenols into K2CO3 solution followed by chloroacetylation. When a 12 m OV-1 fused silica capillary column was used, 22 phenol chloroacetates were easily resolved in a single run. Using distilled and natural water samples, this method has been validated and shown to be applicable over a concentration range of 0.1 to 100 micro-g/L of the phenols studied. (Author's abstract)
W86-00002

MULTIRESIDUE METHOD FOR THE ANALYSIS AND VERIFICATION OF SEVERAL HERBICIDES IN WATER,

Department of Agriculture, Regina (Saskatchewan). Research Station.
A. J. Cessna, R. Grover, L. A. Kerr, and M. L. Aldred.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 3, p 504-507, 1985. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Pesticide residues, *Herbicides, *Chemical analysis, *Detection limits, Water analysis, 2,4-D, Bromoxynil, Dicamba, MCPA, Picloram, Triallate, Trifluralin, Gas chromatography.

Because of the diversity of herbicide products available, environmental water samples would best be analyzed for herbicide residues by using a multiresidue procedure. A multiresidue analytical method to determine and verify residues of both neutral and acidic herbicides in water was developed. Acidic herbicides were derivatized by using diazomethane. Recoveries of herbicides (bromoxynil, 2,4-D, dicamba, MCPA, picloram, triallate, and trifluralin) from distilled water at fortification levels of 0.1-1 ppb ranged from 80 to 117%. Except for MCPA, all other herbicide residues could be verified by using two different detector modes. The method was used in a preliminary study to monitor herbicide residues in irrigation return flow waters at the Outlook Irrigation District (Saskatchewan). The supply water from the pumping station, monitored to provide background interferences for the various herbicides, consistently showed trace interferences at the retention time for 2,4-D which were less than the limit of detection. For the first two weeks of sampling, these interferences in the return flow water samples from the drainage ditches reflected what was found in the supply water. The average background interference in the 2,4-D region of the chromatogram was 0.13 ppb whereas those for the dicamba and bromoxynil regions were less than 0.1 ppb in both the supply water and in drainage ditch water prior to the commencement of spraying which occurred after the June 4 sampling; these backgrounds still permitted a limit of detection of 0.5 ppb for all three herbicides. The background interferences in the trifluralin and triallate regions readily permitted a limit of detection of 0.1 ppb. The method showed good reproducibility between duplicate water samples and these residues could be readily confirmed by using a specific gas chromatographic detector (the Hall detector in the halogen mode). (Collier-IVI)
W86-00046

RAPIDITY OF RNA SYNTHESIS IN HUMAN CELLS; A HIGHLY SENSITIVE PARAMETER FOR WATER CYTOTOXICITY EVALUATION,

Service de Controle des Eaux de la Ville de Paris (France).
C. Fauris, C. Danglot, and R. Vilagines.
Water Research, Vol. 19, No. 6, p 677-684, 1985. 5 Fig, 3 Tab, 25 Ref.

Descriptors: *RNA synthesis, *Cytotoxicity testing, *Toxicity testing, *Water pollution effects, *Seine river, *Marne river, *Oise river, *France, Water analysis, Enzymes, Cell physiology, Animal physiology, Animal metabolism.

Effects of several water pollutants were tested, without any concentration, on the main cellular metabolic pathways of cultured human cells. The cellular targets studied were divided into four groups: the microsome and cytosol enzymes group (alkaline phosphatase, uridine kinase, thymidine kinase and ATPase); the mitochondrial enzymes group (ATPase and cytochrome oxidase); the isolated nuclei group (1 function); and the viable cells group (cytoplasmic membrane permeability and protein, RNA, and DNA synthesis). Each enzymatic activity or cellular function was tested in the presence of increasing concentrations of potassium dichromate, potassium cyanide, phenol, actinomycin D, sodium dodecyl sulfate, Triton X-100, and cupric sulfate. This comparison clearly indicated that the rapidity of cellular RNA synthesis was the most sensitive target to many pollutants. When used in the water field this quantitative test does not require preliminary concentration of the water's toxic compounds and, in the case of polluted river waters, requires sample dilution. Response of the test is fast enough to require only a 2 h incubation for highly cytotoxic samples and 20 h incubation for samples of low cytotoxicity. Its simplicity makes it easily adaptable to routine analysis and continuous monitoring of any water. Weekly cytotoxicity determinations were performed for two months on the river Seine at different sampling points around Paris (France) and on the river Marne and the river Oise. Chemical and physical tests were performed on the samples as well. The classification obtained by the whole of physicochemical analysis correlated well with the cytotoxicity testing. The application domain of the test is very large, ranging from surface and ground waters to drinking and bottled mineral waters. (Collier-IVI)
W86-00052

TRACER APPLICATIONS OF ULTRA-VIOLET ABSORPTION MEASUREMENTS IN COASTAL WATERS,

University Coll. of North Wales, Menai Bridge. Marine Science Labs.
For primary bibliographic entry see Field 2L.
W86-00056

ESTIMATION OF PHOSPHORUS FLUX IN A REGULATED CHANNEL,

Inland Waters Directorate, Vancouver (British Columbia). Water Quality Branch.
L. J. Zeman, and H. O. Slaymaker.
Water Research, Vol. 19, No. 6, p 757-762, 1985. 3 Fig, 19 Ref.

Descriptors: *Phosphorus flux, *Okanagan River, *British Columbia, *Regulated flow, Nutrients, Annual distribution, Water sampling, Sampling strategy, Nutrient flux, Load distribution.

During a nutrient loading study in the Okanagan River Basin, British Columbia, the regression relationship between phosphorus concentrations and the Okanagan River discharge was shown to be not statistically significant. Phosphorus flux could, therefore, not be determined by conventional methods which rely on the concentration-discharge relationship. The reason for failure of conventional methods is the regulated nature of the Okanagan River flow. Two sampling strategies for chemical analysis of water samples were applied: (a) simultaneous, based on manual collection of sample replicates; and (b) sequential, using an automatic device to obtain a series of point concentration measurements. These sampling strategies provided a basis for nutrient flux estimation by the following methods; (a) partial load method, resulting from simultaneous sampling; and (b) flow interval method, based on sequential sampling. Load estimates and their confidence limits derived from the partial load method were compared with loads obtained by the flow interval method. There was a high level of correlation between the load estimates. Annual trends are more appropriately investigated by the flow interval method, cross-sectional load variability and confidence limits should be assessed by the partial load method. (Author's abstract)
W86-00062

ASSESSMENT OF HEAVY METALS AND PCB'S AT SELECTED SLUDGE APPLICATION SITES IN ONTARIO,

Department of the Environment, Ottawa (Ontario).
M. D. Webber, H. D. Monteith, and G. M. Corneau.
Environment Canada, Canada-Ontario's Agreement on Great Lakes Water Quality, Research Report No. 109, 1981. 27 p, 2 Fig, 10 Tab, 16 Ref.

Descriptors: *Fate of pollutants, *Bioaccumulation, *Sludge disposal, *Sludge utilization, *Grain crops, *Heavy metals, *Polychlorinated biphenyls. *Plant tissues, Path of pollutants, Land disposal, Metals, Cadmium, Zinc, Waste disposal, Molybdenum, Corn, Wheat, Oats, Ruminants, Solid waste disposal.

Ten sludge application sites were sampled during the summers of 1976 and 1978 for PCB and metal concentrations in soil and plants. Determinations of PCB and metal loadings showed that metal loadings exceeded the maxima recommended in the Ontario Sludge Utilization Guidelines at several sites. Sludge application increased the total metal and PCB contents and the DTPA-extractable metals in the soils. The largest increases generally coincided with the largest estimated loadings. The effects of sludge application on plants were minimal, except for an increase of Cd and Zn contents in plant materials. Stratford sludge contributed a heavy Mo loading and greatly increased the Mo content of corn leaves at that site. An exclusive diet of corn leaves from the Stratford site would cause Mo-induced Cu deficiency in ruminant animals. Increased Zn concentrations in plants would be desirable because Zn is usually deficient in plant and animal nutrition. However, increased Cd

levels are undesirable because of the metal's toxicity to both plants and animals. Sludge application to land according to the Ontario Guidelines will not cause deleterious uptake of heavy metals by corn, oats and wheat.
W86-00102

WATER-QUALITY APPRAISAL, MAMMOTH CREEK AND HOT CREEK, MONO COUNTY, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
J. G. Setmire.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigations Report 84-4060, 1984. 50 p, 15 Fig, 15 Tab, 6 Ref.

Descriptors: *Eutrophication, Dissolved oxygen, *Algal growth, *Mineralization, Nitrates, *Sedimentation, *Bacteria, *California, Mammoth Creek, Hot Creek, Mono County, *Mammoth Lakes.

A late summer reconnaissance in 1981 and a spring high-flow sampling in 1982 of Mammoth Creek and Hot Creek, located in the Mammoth crest area of the Sierra Nevada, indicated that mineralization, eutrophication, sedimentation, and limited areas of fecal contamination were occurring. Mineralization, indicated by a downstream increase in dissolved-solids concentration, was due primarily to geothermal springs that gradually decreased in the percentage of calcium, increased in the percentage of magnesium and sodium, and caused fluctuating, but overall increasing percentage of fluoride, sulfate, and chloride. Resulting water quality in Mammoth Creek was similar to that of the springs forming Hot Creek. Eutrophication was observed in Twin Lakes and the reach of Hot Creek below the fish hatchery. Twin Lakes had floating mats of algae and a high dissolved-oxygen saturation of 147 percent at a pH of 9.2. Hot Creek had excessive aquatic vascular plant and algae growth, dissolved-oxygen saturations ranging from 65 to 200 percent, algal growth potential of 30 milligrams per liter, and nitrates and phosphates of 0.44 and 0.157 milligrams per liter. Sedimentation was noted in observations of bed-material composition showing the presence of fine material beginning at Sherwin Creek Road. Fecal contamination was indicated by fecal coliform counts of 250 colonies per 100 milliliters and fecal streptococcal counts greater than 1,000 colonies per 100 milliliters. (USGS)
W86-00106

HYDROGEOLOGIC AND WATER-QUALITY CHARACTERISTICS OF THE MOUNT SIMON-HINCKLEY AQUIFER, SOUTHEAST MINNESOTA,

Geological Survey, St. Paul, MN. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-00109

QUALITY OF WATER, QUILLAYUTE RIVER BASIN, WASHINGTON,

Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-00111

INVESTIGATION OF WAIKELE WELL NO. 2401-01, OAHU, HAWAII: PUMPING TEST, WELL LOGS AND WATER QUALITY,

Geological Survey, Honolulu, HI. Water Resources Div.
For primary bibliographic entry see Field 2K.
W86-00118

ASSESSMENT OF WATER RESOURCES IN LEAD-ZINC MINED AREAS IN CHEROKEE COUNTY, KANSAS, AND ADJACENT AREAS,

Geological Survey, Lawrence, KS. Water Resources Div.
T. B. Spruill.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Open-File Report 84-439, (1984). 102 p, 23 Fig, 26 Tab, 35 Ref.

Descriptors: *Mine drainage, *Groundwater contamination, *Stream pollution, *Groundwater hydrology, Water quality, *Water quantity, *Kansas, Cherokee, Lead and zinc mines.

A study was conducted to evaluate water-resource problems related to abandoned lead and zinc mines in Cherokee County, and adjacent areas in Oklahoma and Missouri. Discontinuities and perforations, which were produced by mining in the confining shale west of the Pennsylvanian-Mississippian geologic contact, have created artificial groundwater recharge and discharge areas. Abandoned wells and drill holes present the greatest contamination hazard to water supplies in the deep aquifer. There is a potential for downward movement from the shallow to the deep aquifer throughout the study area, with greatest potential in Ottawa County, Oklahoma. Principal effects of abandoned mines on groundwater quality are lowered pH and increased concentrations of sulfate and trace metals of water in the mines. No conclusive evidence of lateral migration of contaminated mine water from the mines into the water-supply wells adjacent to the mines was found. Analyses of water from the deep aquifer did not indicate trace-metal contamination. The effects of abandoned mines on streamwater quality are most severe in Short Creek and Tar Creek. Increased concentrations of zinc and manganese were observed in the Spring River below Short Creek Kansas. (USGS)
W86-00121

TREND ANALYSIS OF SALT LOAD AND EVALUATION OF THE FREQUENCY OF WATER-QUALITY MEASUREMENTS FOR THE GUNNISON, THE COLORADO, AND THE DOLORES RIVERS IN COLORADO AND UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-00123

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.

Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W86-00129

CHEMISTRY FOR OPERATORS,

Muskegon County Board, MI. Dept. of Public Works.
For primary bibliographic entry see Field 5F.
W86-00134

LABORATORY PROTOCOLS FOR EVALUATING THE FATE OF ORGANIC CHEMICALS IN AIR AND WATER,

SRI International, Menlo Park, CA.
T. Mill, W. R. Mabey, D. C. Bomberger, T.-W. Chou, and D. G. Hendry.
EPA-600/3-82-022, July 1982. Environmental Research Laboratory, Athens, GA. 329 p, 21 Fig, 46 Tab, 287 Ref. Contract/Grant No. 68-03-2227.

Descriptors: *Fate of pollutants, *Testing procedures, *Air pollution, *Water pollution, *Organic compounds, Biotransformation, Oxidation, Aquatic habitats, Hydrolysis, Photolysis, Sorption.

Laboratory test procedures (or protocols) have been developed to provide data useful in evaluating the environmental fate of organic compounds in natural aquatic systems and in the atmosphere. Screening-level protocols are described to estimate rate constants for hydrolysis, photolysis, oxidation, biotransformation, volatilization processes in natural aquatic systems, and a screening protocol for measurement of partition coefficients for sorption of organic chemicals to sediments is also described. Detailed test protocols have been developed for the hydrolysis, photolysis, volatilization, and sediment-sorption processes to obtain more accurate and precise data for use in enviromental assessments applied to aquatic systems. Screening and detailed test protocols are described for estimating rate constants for the atmospheric photolysis and oxidation of organic compounds. For each process, the theory and the present state of knowledge regarding the environment are reviewed, and some common methods currently in use are critically evaluated. (Author)
W86-00154

MICROBIOLOGICAL WATER QUALITY OF IMPOUNDMENTS: A LITERATURE REVIEW,

Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
G. A. Burton.
Miscellaneous Paper E-82-6, December 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 53 p, 5 Tab, 210 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Literature review, *Sampling, *Water quality, *Reservoirs, *Microbiologial studies, *Bacterial analysis, Water sampling, Indicators, Bioindicators, Coliforms, Public health, Diseases, Pathogens, Parasites, Viruses.

Assessing the microbiological water quality of impoundments and the potential for waterborne disease outbreaks is a difficult task when using traditional sampling programs. Problems associated with using fecal coliform bacteria as indicators of human pathogen presence complicates assessments of future water quality in preimpoundment areas. Reliable determination of future and present microbiological water quality requires knowledge of how the chemical, physical, and biological characteristics of the watershed and impoundment interrelate to influence microbial indicator and pathogen densities. Accurate estimates of microbial indicator and pathogen densities, obtainable by using the enumeration methods and their modifications suggested in this report, will allow monitoring of the proper indicator organisms and estimation of potential sites of pathogen occurrence, density, and survival. Sampling programs must be geared toward critical time periods and areas; i.e., summer months, storm flows, feeder streams, agricultural and urban runoff, and swimming areas, including water and sediments. Frequency of sampling should be dictated by variability of water conditions, confidence level of data, and extent of human contact. Choice of proper indicator organisms and enumeration methods and appropriate sampling strategies will allow sound preimpoundment assessment and reservoir management to greatly reduce the risk of waterborne disease outbreaks. (Author)
W86-00185

PROCEDURES FOR HANDLING AND CHEMICAL ANALYSIS OF SEDIMENT AND WATER SAMPLES,

State Univ. of New York Coll. at Buffalo. Great Lakes Lab.
R. H. Plumb.
Technical Report EPA/CA-81-1, May 1981. Army Engineer Waterways Experiment Station, Vicksburg, MS. 482 p, 52 Fig, 32 Tab, 44 Ref. Contract/Grant No. EPA-4805572010.

Descriptors: *Pollutant identification, *Chemical analysis, *Sediments, *Sampling, *Water analysis, Sample preparation, Sample preservation, Bottom sampling, Dredging, Organic compounds, Cation exchange capacity, Particle size, Hydrogen ion concentration, Oxidation-reduction potential, Inorganic compounds, Carbon, Metals, Nitrogen compounds, Ammonia, Phosphates, Sulfides, Carbamates, Chlorinated hydrocarbons, Oil, Pesticides, Insecticides, Herbicides, Phenolic compounds, Biochemical oxygen demand, Chemical oxygen demand, Sediment oxygen demand, Oxygen demand.

This handbook provides guidance for sampling, preservation, and analysis of dredged and fill material. Its emphasis is on regulatory affairs rather than research. Section 1 shows a project manager

the trade-offs involved in developing a sampling program. Factors which must be considered are sampling locations, sampling equipment, number of samples, types of tests, and specific chemical analyses. Section 2 shows laboratory and field personnel how to implement the sampling program. This includes the sample equipment and handling as well as the three general chemical tests: standard elutriate test, bulk analysis, and sediment fractionation. Section 3 gives details of analytical techniques for 44 parameters, including physical analysis (cation exchange capacity, particle size, pH, oxidation reduction potential, total and volatile solids, specific gravity), inorganic analysis (carbon, metals, nitrogen and compounds, phosphates, sulfides), organic analysis (carbamates, herbicides, insecticides, oil/grease, phenolics), chlorine demand, biochemical oxygen demand, chemical oxygen demand, and sediment oxygen demand.
W86-00198

MICROCOMPUTER ASSISTED QUALITY ASSURANCE,

Lotic Enterprises, Bakersfield, CA.
G. Hill.
1984, 106 p.

Descriptors: *Pollutant identification, *Wastewater treatment, *Water analysis, *Computer programs, *Quality control, *Statistical methods, Bacterial analysis, Chemical analysis, Physical analysis, Sampling, Standards, Standard deviation, Correletion analysis, Equations, Error analysis, Precision, Detention time, Corrosion, Larson/Langlier saturation index, Saturation index, Metric system, Mathematical studies.

Computer programs written in BASIC are given for quality assurance programs in water analysis and wastewater treatment laboratories. Each computer program includes a program description, documentation which the user must enter, the definition of variables, an example, a run, and a listing of the program. Some of the programs are organization of samples, typical report forms, internal standard method, standard addition (for determining low levels of the analyte), standard deviation, control charts, linear correlation coefficient, equation of the straight line, linear regression, linear interpolation from a single point, atomic absorption detection limits, percent recovery, mean error accuracy, anion-cation balance, feed rates, detention times, corrosive tendency, Larson/Langelier saturation index, and metric unit conversion.
W86-00203

METHODS FOR ECOLOGICAL TOXICOLOGY: A CRITICAL REVIEW OF LABORATORY MULTISPECIES TESTS.

Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W86-00210

MONITORING MARINE MICROBIAL FOULING.

National Aeronautics and Space Administration, Huntsville, AL. George C. Marshall Space Flight Center.
Technical Support Package, MFS-25928, Spring 1984. 23 p, 1 Tab.

Descriptors: *Pollutant identification, *Microorganisms, *Fouling, *Bacterial analysis. *Microbiological studies, Microscopy, Films.

A method for monitoring biofouling on metal surfaces and nylon parachute material immersed in seawater was developed. It involves a combination of scanning electron microscopy and isolation, enumeration, and identification of biofouling microorganisms, using standard microbiological culture methods. Marine biofouling increases with length of exposure of the water and with water temperature. The polysulfide sealant and nylon parachute material were more readily biofouled than metallic surfaces. Spray washing was not effective for removing deposits of organic biofilm.
W86-00227

SAMPLING FREQUENCY - MICROBIOLOGICAL DRINKING WATER REGULATIONS: FINAL REPORT,

Drexel Univ., Philadelphia, PA. Dept. of Biological Sciences.
W. O. Pipes, and R. R. Christian.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-127738. EPA/570/9-82-001, September 1982. Environmental Protection Agency, Washington, DC. Office of Drinking Water. 174 p, 22 Fig, 70 Tab, 25 Ref, Append.

Descriptors: *Pollutant identification, *Water analysis. *Water distribution, *Sampling, *Bacteria, Coliforms, Microorganisms, Monitoring, Microbiological studies.

A sampling model was developed to specify the sampling frequency needed to determine compliance with the microbiological maximum contaminant levels of the Natinal Interim Primary Drinking Water Regulations. Two approaches were used: empirical, based on fitting coliform data to frequency distributions; and mechanistic, done by analyzing the physical elements of the system to determine the distribution of coliforms throughout a water system. In the empirical approach the truncated lognormal distribution was chosen. In this case coliform densities $< 1/100$ ml or $> 80/100$ ml cannot be measured. The probability of violation is a function of the densities of coliforms, the number of samples collected, and the parameters of the lognormal distribution. Therefore a higher degree of aggregation of coliform bacteria leads to larger numbers of samples being needed for detection of contamination. The mechanistic approach showed that the water distribution system could be divided into hydraulically isolated sections. It was concluded that all sections must be included in the monitoring program to get an accurate measure of coliform occurrence. Coliform occurrence did not differ between peripheral and nonperipheral locations or with distance from the water source. Thus sampling locations for a microbiological monitoring program can be selected on a randomized basis.
W86-00245

ADDENDUM TO HANDBOOK FOR SAMPLING AND SAMPLE PRESERVATION.

Environmental Monitoring and Support Lab.-Cincinnati, OH.
EPA-600/4-83-039, August 1983, 28 p, 3 Tab.

Descriptors: *Water analysis, *Pollutant identification, *Sampling, *Water sampling, *Sample preparation, *Monitoring, Sample preservation, Preservation, Monitoring, Water analysis.

This addendum has an updated and expanded Table 2.3, listing automatic samplers and their characteristics. In addition, the definitions of sample types (discrete, composite, flow proportional composite, hand proportioned composite, sequential composite, and continuous composite) have been revised. Additional references on samplers and sampling are listed.
W86-00268

SAMPLING AND DETECTION OF TAGGED DREDGED MATERIAL,

Argonne National Lab., IL. Energy and Environmental Systems Div.
L. S. Van Loon, D. L. McCown, and J. D. Ditmars.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82016056. ANL/EES-TM-169, January 1982. 29 p, 17 Fig, 5 Ref. Contract/Grant No. W-31-109-Eng-38.

Descriptors: *Pollutant identification, *Dredging, *Sediment transport, Sand, Sampling, Ultraviolet radiation, Fluorescence.

Systems for sampling and detecting tagged dredged sand in the Upper Mississippi River were develped by Argonne National Laboratory for the U.S. Army Corps of Engineers, Rock Island District. The Corps plans to demonstrate main-channel disposal of dredged material, and it requires systems to detect the movement of the dredged material after the material has been placed in a deep reach of river. The dredged material in the demonstration will be tagged with sand particles coated with fluorescent dye. Argonne designed systems for sampling of the bottom surficial sediments at discrete points along transects from a boat that employs a precision navigation system; onboard visual inspection of the samples for dyed sand in an ultraviolet light box; and photography of ultraviolet-illuminated samples. This report describes the systems and their uses as well as the results of tests to determine proper settings for photographic equipment. (Author)
W86-00288

5B. Sources Of Pollution

AVERAGE RAINWATER PH, CONCEPTS OF ATMOSPHERIC ACIDITY, AND BUFFERING IN OPEN SYSTEMS,

Texas Univ. at Austin. Dept. of Environmental Health Engineering.
H. M. Liljestrand.
Atmospheric Environment, Vol. 19, No. 3, p 487-499, 1985. 4 Fig, 2 Tab, 24 Ref, 2 Append. EPA grant R810148-01 and California Air Resources Board grant A7-110-30.

Descriptors: *Acid rain, *Chemistry of preciptation, *Hydrogen ion concentration, *Chemical reactions, *Buffering, Carbon dioxide, Ammonia, Hydrochloric acid, Nitrates, Sulfur dioxide, Carbonate, Air pollution.

The system of water equilibrated with a constant partial pressure of CO2, as a reference point for pH acidity-alkalinity relationships, has nonvolatile acidity and alkalinity components as conservative quantities, but not H(+) concentration. Simple algorithms were developed for the determination of the average pH for combinations of samples both above and below pH 5.6. Averaging the nonconservative quantity H(+) concentration yields erroneously low mean pH values. To extend the open CO2 system to include other volatile atmospheric acids and bases distributed among the gas, liquid and particulate matter phases, a theoretical framework for atmospheric acidity was developed. Within certain oxidation-reduction limitations, the total atmospheric acidity (but not free acidity) is a conservative quantity. The concept of atmospheric acidity was applied to air-water systems approximating aerosols, fogwater, cloudwater and rainwater. The buffer intensity in hydrometeors is a function of net strong acidity, partial pressures of acid and base gases and the water to air ratio. For high liquid to air volume ratios, the equilibrium partial pressures of trace acid and base gases are set by the pH or net acidity controlled by the nonvolatile acid and base concentrations. For low water to air volume ratios as well as stationary state systems such as precipitation scavenging with continuous emissions, the partial pressures of trace gases (NH3, HCl, HNO3, SO2 and CH3COOH) appear to be of greater or equal importance as carbonate species as buffers in the aqueous phase. (Author's abstract)
W86-00001

CHLORINATED ORGANICS IN SIMULATED GROUNDWATER ENVIRONMENTS,

Florida International Univ., Miami. Drinking Water Research Center.
F. Parsons, and G. B. Lage.
Journal of the American Water Works Association, Vol. 77, No. 5, p 52-59, May, 1985. 9 Fig, 7 Tab, 27 Ref.

Descriptors: *Chlorinated hydrocarbons, *Groundwater, *Biotransformation, *Degradation, Biodegradation, Fate of pollutants, Trichloroethane, Tetrachloromethane, Trichlormethane, Dichloroethane.

Tetrachloromethane and 1,1,1-trichloroethane were transformed in microcosms composed of aquifer materials to trichloromethane and 1,1-dichloroethane, respectively. Further observations of tri- and tetrachloroethane in microcosms demonstrated

the transformation of these compounds to dichloroethane. Biotransformation products of these four solvents by freshwater sediment microbiota, in sealed static microcosms, were determined by gas chromatography during incubation at ambient temperatures in the dark for periods of up to 16 weeks. Under conditions of neutral to acid pH, reductive potential, and the absence of oxygen and light, reductive dehalogenation of these four compounds occurred. Chlorinated alkenes were consistently more resistant to biotransformation than the chlorinated alkanes. (Author's abstract)
W86-00007

AWWA SURVEY OF INORGANIC CONTAMINANTS IN WATER SUPPLIES.

For primary bibliographic entry see Field 5F.
W86-00009

SURFACE BUOYANT JETS IN STEADY AND REVERSING CROSSFLOWS,

Worcester Polytechnic Inst., Holden, MA. Alden Research Labs.
D. N. Brocard.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 793-809, May, 1985. 10 Fig, 2 Tab, 19 Ref.

Descriptors: *Buoyant jets, *Crossflows, *Plumes, *Heated water, Path of pollutants, Buoyant spreading, Boundary effects, Water currents.

Data on suface buoyant jets in steady and reversing crossflows was obtained with experiments conducted in a 130 ft (40 m) by 81 ft (25 m) by 1.5 ft (0.45 m) deep basin, which was large enough to ensure negligible boundary effects while allowing controlled ambient conditions. The test results are presented nondimensionally and referenced to controlling length scales. The steady crossflow results are trajectories and longitudinal temperatures, which show the effects of the discharge buoyancy and initial flow rate. Comparing these results with those of other experimental studies leads to the suspicion that boundary effects may be present in some of the latter. The reversing crossflow tests furnish surface temperature patterns and plume depths for a range of conditions. These results can be used to evaluate mathematical models. In addition, the effects of tidal reversal on the offshore extent and depth of the plume are examined. Dispersion tests reveal that buoyancy played an important role in plume spreading. This factor is important as buoyant spreading is frequently omitted in two dimensional farfield mathematical models of thermal plumes. (Author's abstract)
W86-00014

DISPERSION IN ANISOTROPIC, HOMOGENEOUS, POROUS MEDIA,

Baghdad Univ. (Iraq). Coll. of Engineering.
For primary bibliographic entry see Field 2F.
W86-00015

INITIAL DILUTION FOR OUTFALL PARALLEL TO CURRENT,

Monash Univ., Clayton (Australia). Dept. of Mechanical Engineering.
J. B. Hinwood, and I. G. Wallis.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 828-845, May, 1985. 7 Fig, 2 Tab, 10 Ref, 2 Append. Australian National Energy Research Development and Demonstration Council grant 78/2799.

Descriptors: *Outfalls, *Dilution, *Currents, *Diffusers, Thermal pollution, Wastewater outfall, Plumes, Buoyancy.

Rotary tidal currents or site constraints can result in an outfall diffuser being alined with the current in shallow water. Experiments using a small model laboratory diffuser flume and a much larger scale model in an estuarine channel were used to establish the significant processes causing initial dilution of effluent discharged from a multiport diffuser alined parallel to the ambient current. From considerations of momentum conservation and mixing, and the results of the flume experiments, an expression for the initial dilution in shallow water was obtained the conditions defining shallow water were established. The results of the field experiments carried out in an estuarine channel were in agreement with the laboratory results and verified the derived expression. A relationship between the initial dilution and the angle between the diffuser and the current was developed from the field studies. (Author's abstract)
W86-00016

REGIONAL UNSTEADY INTERFACE BETWEEN FRESH WATER AND SALT WATER IN A CONFINED COASTAL AQUIFER,

Ehime Uuiv., Matsuyama (Japan). Dept. of Ocean Engineering.
For primary bibliographic entry see Field 2F.
W86-00042

FATE OF ALDICARB, ALDICARB SULFOXIDE, AND ALDICARB SULFONE IN FLORIDAN GROUNDWATER,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
C. J. Miles, and J. J. Delfino.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 3, p 455-460, 1985. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Aldicarb, *Pesticides, *Florida, *Groundwater contamination, *Fate of pollutants, Chemical reactions, Degradation, Hydrolysis, Limestone, Biodegradation, Microcosms.

The fate of aldicarb, aldicarb sulfoxide, and aldicarb sulfone in Floridan groundwater microcosms was determined. One reaction mechanism observed was base hydrolysis and degradation rates decreased in the order, sulfone > sulfoxide >> aldicarb. Appearance of oximes followed the disappearance of corresponding parent compounds while appearance of nitriles was minor and rarely observed. Microcosms amended with crushed limestone showed rates of hydrolysis that were 4-5 times slower than microcosms without limestone. Oxidation of aldicarb to the sulfoxide was minimal within 70 days whereas in separate experiments, the reduction of the sulfoxide to aldicarb was significant over the same time period. The sorption of aldicarb, aldicarb sulfoxide, and aldicarb sulfone onto limestone was not observed. (Author's abstract)
W86-00045

LABORATORY AND FIELD STUDIES ON THE FATE OF 1,3,6,8-TETRACHLORODIBENZO-P-DIOXIN IN SOIL AND SEDIMENTS,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. C. G. Muir, A. L. Yarechewski, R. L. Corbet, G. R. B. Webster, and A. E. Smith.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 3, p 518-523, 1985. 1 Fig, 6 Tab, 21 Ref.

Descriptors: *Dioxins, *Sediments, *Soil, *Fate of pollutants, Degradation products, Carbon radioisotopes, Isotope studies, Lake sediments.

The fate of C-14-ring-labeled 1,3,6,8-tetrachlorodibenzo-p-dioxin (TCDD) was studied in sandy loam soil under field conditions and in silty-clay pond and lake sediments under laboratory conditions. Dissipation of 1,3,6,8-TCDD from small field plots was relatively rapid with 44% of the applied radioactivity lost after 131 days post-treatment. In sediment, 80% of the radioactivity could still be accounted for as intact chemical after 675 days under static aerobic conditions (10 and 25 C) or after 310 days under a nitrogen or air purge. Transformation of 1,3,6,8-TCDD to degradation products and unextractable radioactivity in soils and sediments was very slow. Unidentified polar products represented a maximum of 2.5% of extractable C-14 in field soils and 7.0% in sediments. DDT incubated in sediments under the same conditions had half-lives of < 310 days. (Author's abstract)
W86-00047

HETEROTROPHIC SLIMES IN IRISH RIVERS, EVALUATION OF THE PROBLEM,

Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
N. F. Gray, and C. A. Hunter.
Water Research, Vol. 19, No. 6, p 685-691, 1985. 2 Fig, 10 Tab, 14 Ref.

Descriptors: *Slimes, *Fungus, *Heterotrophic slimes, *Ireland, *Rivers, Surveys, Water pollution effects, Fish kills, Odors.

A questionnaire survey was used to determine the frequency of occurrence, extent and duration of slime growth in Irish rivers. Other factors such as the source of slime-promoting effluents, the degree of treatment given to effluents prior to discharge and the effects slime growth was having on watercourses were also examined. 156 outbreaks were recorded throughout Ireland which affected approx 350 km of channel. Discharges from the agricultural processing industry and domestic sewage were most frequently associated with slime outbreaks. Few of the outbreaks were insignificant in length with 33.7% in excess of 1 km and 13.5% in excess of 5 km. Although 12.6% of outbreaks resulted in no adverse effects on watercourses, major problems reported included the appearance and amenity value being adversely affected (86.4%), smell and deoxygenation (46.6%), damage to fish stocks (37.9%) and problems of sloughed flocs of slime (24.3%). The severity of these adverse effects was directly related to the length of outbreaks. The situation in Ireland was compared to England and Wales. (Author's abstract)
W86-00053

GROUNDWATER SEEPAGE NUTRIENT LOADING IN A FLORIDA LAKE,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 2H.
W86-00065

RELEASE OF ENDOTHALL FROM AQUATHOL GRANULAR AQUATIC HERBICIDE,

North Texas State Univ., Denton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5G.
W86-00068

ALTERNATING DIRECTION GALERKIN TECHNIQUE FOR SIMULATION OF CONTAMINANT TRANSPORT IN COMPLEX GROUNDWATER SYSTEMS,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
A. D. Daus, and E. O. Frind.
Water Resources Research Vol. 21, No. 5, p 653-664, May, 1985. 14 Fig, 2 Tab, 20 Ref. Natural Sciences and Research Council of Canada operating grant A8368.

Descriptors: *Contamination, *Path of pollutants, *Solute transport, Finite element method, Computers, Simulation, Groundwater flow, Groundwater pollution.

A general contaminant transport simulation technique based on a Galerkin finite element representation in space and an alternating direction time-stepping scheme is developed. The formulation, which is in terms of natural coordinates following the principal directions of hydraulic conductivity of the medium, decouples the spatial components of the equations, leading to tridiagonal matrices. The numerical accuracy can be easily controlled in each principal direction through the well-established Peclet and Courant numbers. The ADG2 technique showed excellent potential for application to a variety of groundwater contamination scenarios. Applied to an isotropic, homogeneous system, it possesses the same favorable performance characteristis as the PD method of Frind and Pinder. These include delivery of equal or better accuracy compared with the conventional two-dimensional finite element technique; control over numerical dispersion through the Peclet and Courant criteria; independence of the numerical accuracy on the element aspect ratio; and low operations count, low core storage requirements, and

low solution roundoff error. The ADG2 technique possesses some distinct advantages over the P method; a grid that is invariant in time; applicability to transient flow conditions; and an ability to handle anisotropic flow systems and complex stratigraphy. The ADG2 technique retains both the flexibility of the finite element method and the efficiency of the alternative direction technique. Because of its simple structure and the absence of large banded matrices, the algorithm could provide a base for more complex modes such as those combining geochemical reactions with advective-dispersive transport. (Baker-IVI)
W86-00072

ANALYSIS AND INTERPRETATION OF SINGLE-WELL TRACER TESTS IN STRATIFIED AQUIFERS,

Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-00074

ONE-DIMENSIONAL ANALYTICAL SOLUTIONS FOR THE MIGRATION OF A THREE-MEMBER RADIONUCLIDE DECAY CHAIN IN A MULTILAYERED GEOLOGIC MEDIUM,

Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
A. B. Gureghian, and G. Jansen.
Water Resources Research, Vol. 21, No. 5, p 733-742, May, 1985. 9 Fig, 3 Tab, 13 Ref, 2 Append.

Descriptors: *Path of pollutants, *Groundwater pollution, *Radioactive wastes, Transport, Waste disposal, Radionuclides, Laplace equation, Computers.

The Laplace transform method was used to analytically solve the one-dimensional transport equation of a three-member decay chain in a stratified geologic medium. The solution for the nondispersive case is exact. The solution for the general case, although analytic in the first layer, takes a semianalytical form in the subsequent layers by virtue of its numerical integration requirements. Two types of boundary conditions are considered at the source, i.e., a continuous and a band release mode. The accuracy of the solutions was satisfactorily tested on a selected number of problems for which experimental and analytical solutions were available. The practical use of the solutions in a two-dimensional domain is illustrated by a scenario of radionuclide migration from a high level waste repository located in a saturated multilayered aquifer. The computational scheme was programmed in FORTRAN IV and executed on a CDC/CYBER-74-NOS-BE operating system. (Baker-IVI)
W86-00081

SEDIMENT-WATER INTERFACE IN MODELING PESTICIDES IN SEDIMENTATION PONDS,

Princeton Univ., NJ. Dept. of Civil Engineering.
P. R. Jaffe, and R. A. Ferrara.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 53-64, 6 Fig, 1 Tab, 4 Ref.

Descriptors: *Model studies, *Bottom sediments, *Sedimentation, *Pesticide kinetics, *Sediment transport, *Adsorption, *Fate of pollutants, *Sedimentation basins, Settling basins, Pesticides, Models, Simulation analysis, Partition coefficient, Particulate matter, Path of pollutants.

A model was developed to study what effect a sedimentation pond may have on the pesticide load carried via sediment transport to receiving waters. The water column of the pond is represented as a completely mixed system. To model this system, equations are required to describe the changes in volume, suspended sediments, adsorbed pesticide concentration, dissolved pesticide concentration, and pesticide concentration in the bottom sediments. Results of several simulations showed that the peak concentration of pesticides in the sedimentation pond is about 3% of the peak storm runoff concentration without a pond. If the partition coefficient is increased, the reduction of the peak concentration is even higher, indicating the improved removal efficiency of the sedimentation process. If no decay occurs, the total yearly load to the receiving waters will be the same with or without a pond once final conditions occur (after a few seasons). If some decay occurs, the total yearly load at final conditions will be less with a pond than without one.
W86-00088

MIXING ZONE MODEL FOR CONSERVATIVE PARAMETERS,

Oklahoma Water Resources Board, Oklahoma City.
For primary bibliographic entry see Field 5G.
W86-00089

SOME RECENT ADAPTATIONS AND APPLICATIONS OF QUAL-II IN THE NORTHEAST,

W. W. Walker.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 87-101, 5 Fig, 1 Tab, 22 Ref.

Descriptors: *Computer models, Models, *Model studies, *Water quality, *Dissolved oxygen, *Nitrogen, *Phosphorus, *Nutrients, Waste load, Rivers, River basins, Simulation analysis, Phytoplankton, Ammonia, Algae.

The modifications of the QUAL-II model to improve simulations of dissolved oxygen conditions in rivers heavily impacted by photosynthesis are discussed along with recent applications of the model in New England. To improve simulations of phytoplankton, nutrients, and oxygen compartments were added for detrital organic P and organic N, algal uptake of ammonia and/or nitrate N, self-shading by phytoplankton, and specification of alternative nutrient limitation by N or P. The Vermont Agency of Environmental Conservation used the QUAL-II model during a wasteload allocation study on the Winooski River when assessing the possible requirements for advanced waste treatment. The Sebasticook River study examined the impacts of a combined municipal/industrial discharge on a small stream (upper east branch) which discharges into an inlet of Lake Sebasticook, a eutrophic Maine lake. The model was also applied to the Sudbury/Concord Rivers in Massachusetts as part of an assessment of the potential environmental constraints involved in diverting waters from the upper watershed for water supply purposes. Interfacing the model output with SAS and plotting routines facilitates calibration, testing, and statistical analysis of observed and predicted water quality profiles. The revised code can be used on microcomputers or mainframes with FORTRAN capability.
W86-00090

REVIEW OF MODEL USE IN EVALUATING NONPOINT SOURCE LOADS FROM FOREST MANAGEMENT ACTIVITIES,

National Council of the Paper Industry for Air and Stream Improvement Inc., New York.
G. G. Ice, and R. C. Whittemore.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 102-122, 6 Fig, 7 Tab, 24 Ref.

Descriptors: *Forest management, *Forest watersheds, Sediments, Erosion, *Nonpoint pollution sources, *Model studies, *Hydrologic models, *Water quality management, *Channel erosion, Water quality, *Soil erosion, Erosion, Landslides, Models, Prediction, Stream degradation.

There is currently an urgent need to validate models that predict water quality, streambed, and stream biota responses to forest practices due to the Clean Water Act and the diverse silvicultural nonpoint source (NPS) control programs developed under Section 208. In addition to regulatory requirements for the use of models, the forestry community has recently begun to consider the consequences of multiple forest operations on water quality. Models are needed to predict not only changes in sediment concentration (the traditional NPS measure for forest practice impacts on water quality) but also changes in channel conditions and the beneficial uses of the water. In response to these demands, the EPA published 'An approach to Water Resources Evaluation of Nonpoint Silvicultural Sources' (WRENSS) in 1980. The sediment prediction components of WRENS include models for water quantity, surface erosion, landslides, and total potential sediment and channel modification. The National Council for Air and Stream Improvement (NCASI) has used WRENSS to predict baseline sediment yields from undisturbed basins. NCASI is collecting data from landslide surveys to enhance predictive methods. The Siuslaw National Forest procedures predict a number of forest-wide responses to various stresses. The areas where model development are needed are identified along with research programs that would enhance understanding of forest water quality modeling.
W86-00091

MECHANISTIC SIMULATION FOR TRANSPORT OF NONPOINT SOURCE POLLUTANTS,

Simons, Li and Associates, Inc., Fort Collins, CO.
D. B. Simons, R.-M. Li, and K. G. Eggert.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 146-160, 5 Fig, 13 Ref.

Descriptors: *Model studies, *Watershed management, *Erosion, *Simulation analysis, *Nonpoint pollution sources, *Fate of pollutants, *Path of pollutants, Watersheds, Nutrients, Organic matter, Dissolved solids, Pesticides, Sediments, Stream degradation, Bank erosion, Channel erosion.

A simulation model for evaluation of alternative management parameters is presented. The model may be used to predict watershed response to land use, including both planned and unplanned events. Nonpoint source pollution from these events may include loading of streams by sediment from erosion, thermal energy, biological contaminants, organic debris, nutrients and dissolved solids, pesticides, and other wastes in solution or adsorbed to sediments. The simulation consists of a soil-plant-atmospheric water simulation for adjusting soil moisture as a function of evaporation, evapotranspiration, soil water hydraulics, and snowmelt, and a kinematic wave surface water routing component. Other model compartments predict hydraulically-based sediment yield, subsurface flow, temperature and dissolved oxygen, pollutant routing and streambank erosion and forest litter routing. This preliminary planning model should be useful in evaluating selected alternatives as a function of environmental goals.
W86-00092

ASSESSMENT OF HEAVY METALS AND PCB'S AT SELECTED SLUDGE APPLICATION SITES IN ONTARIO,

Department of the Environment, Ottawa (Ontario).
For primary bibliographic entry see Field 5A.
W86-00102

NUTRIENT INPUT FROM THE LOXAHATCHEE RIVER ENVIRONMENTAL CONTROL DISTRICT SEWAGE-TREATMENT PLANT TO THE LOXAHATCHEE RIVER ESTUARY, SOUTHEASTERN FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
W. H. Sonntag, and B. F. McPherson.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4020, 1984. 23 p, 3 Fig, 8 Tab, 4 Ref.

Descriptors: *Effluents, *Nutrients, Water quality, Loxahatchee River estuary, *Florida, *Estuaries, *Sewage effluents.

Group 5B—Sources Of Pollution

Two test discharges of treated-sewage effluent were made to the Loxahatchee River in February and September 1981 from the ENCON sewage-treatment plant to document nutrient loading and downstream transport of the effluent to the estuary under maximum daily discharge allowable by law (4 million gallons per day). Concentrations of total nitrogen in the effluent exceeded background concentrations by as much as 7 times during the February test, while concentrations of total phosphorus exceeded background concentrations by as much as 112 times during the September test. The effluent was transported downstream to the estuary in less than 24 hours. Discharge of treated sewage effluent to the river-estuary system in the 1981 water year accounted for less than 0.5 percent of the total nitrogen and 8 percent of the total phosphorus discharged from the major tributaries to the estuary. If maximum discharges of effluent (4 million gallons per day) were sustained throughout the year, annual nitrogen loading from the effluent would account for 5 to 18 percent of the total nitrogen input by the major tributaries to the estuary. With maximum discharges of effluent, annual phosphorus loading would exceed the amount of phosphorus input by the major tributaries to the estuary by 54 to 167 percent. (USGS)
W86-00110

ASSESSMENT OF WATER RESOURCES IN LEAD-ZINC MINED AREAS IN CHEROKEE COUNTY, KANSAS, AND ADJACENT AREAS,

Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-00121

DIGITAL SIMULATION OF THE REGIONAL EFFECTS OF SUBSURFACE INJECTION OF LIQUID WASTE NEAR PENSACOLA, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
M. L. Merritt.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4042, 1984. 73 p, 19 Fig, 1 Tab, 30 Ref.

Descriptors: *Liquid wastes, *Injection, *Waste disposal, *Water pollution effects, *Hydraulic models, *Computer models, *Florida, Water pollution sources, Injection effects, Floridan aquifer.

Industrial, organic, liquid waste has been injected into a part of the lower limestone of the Floridan aquifer at one site since 1963 and at another site since 1975, raising water levels in the injection zone throughout a large region. The hydrogeologic conceptual model of the injection zone is a layer tightly confined above by a thick layer of clay and in which lateral hydraulic conductivity decreases rapidly below the upper 60 feet. Recharge areas are to the north and east, where the confining layer pinches out. There appear to be permeability barriers to the northwest, west, and southwest due to facies changes, faults, or pinchouts. Measured and reconstructed preinjection water levels suggested that flow in the aquifer is from the northern recharge areas toward the southeast. A steady-state model simulation incorporating the cited boundary assumptions approximately simulated this pattern. A two-dimensional flow model and the subsurface waste injection program (SWIP) were calibrated to simulate the water level increases at various monitor wells since 1963. Sensitivity analyses showed the simulations to be quite sensitive to moderate errors in either transmissivity or storage parameter specifications. The predictive use of the hydraulic model is understood to be restricted to the geographical locations of data used for model calibration. (USGS)
W86-00122

TREND ANALYSIS OF SALT LOAD AND EVALUATION OF THE FREQUENCY OF WATER-QUALITY MEASUREMENTS FOR THE GUNNISON, THE COLORADO, AND THE DOLORES RIVERS IN COLORADO AND UTAH,

Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Kircher, R. S. Dinicola, and R. F. Middelburg.
Available from the OFSS, USGS, Box 25425, Lakewood, CO 80225. USGS Water-Resources Investigation Report 84-4048, 1984. 69 p, 20 Fig, 15 Tab, 16 Ref.

Descriptors: *Statistical methods, *Regression analysis, Network design, *Water-quality data, *Salinity, *Colorado, *Utah, Colorado River basin, *Trend analysis.

Monthly values were computed for water-quality constituents at four streamflow gaging stations in the Upper Colorado River basin for the determination of trends. Seasonal regression and seasonal Kendall trend analysis techniques were applied to two monthly data sets at each station site for four different time periods. A recently developed method for determining optimal water-discharge data-collection frequency was also applied to the monthly water-quality data. Trend analysis results varied with each monthly load computational method, period of record, and trend detection model used. No conclusions could be reached regarding which computational method was best to use in trend analysis. Time-period selection for analysis was found to be important with regard to intended use of the results. Seasonal Kendall procedures were found to be applicable to most data sets. Seasonal regression models were more difficult to apply and were sometimes of questionable validity; however, those results were more informative than seasonal Kendall results. The best model to use depends upon the characteristics of the data and the amount of trend information needed. The measurement-frequency optimization method had potential for application to water-quality data, but refinements are needed. (USGS)
W86-00123

PRELIMINARY APPRAISAL OF SEDIMENT SOURCES AND TRANSPORT IN KINGS BAY AND VICINITY, GEORGIA AND FLORIDA,

Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-00125

RUNOFF, SEDIMENT TRANSPORT, AND WATER QUALITY IN A NORTHERN ILLINOIS AGRICULTURAL WATERSHED BEFORE URBAN DEVELOPMENT, 1979-81,

Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 2J.
W86-00133

COEFFICIENTS FOR USE IN THE U.S. ARMY CORPS OF ENGINEERS RESERVOIR MODEL, CE-QUAL-R1,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. D. Collins, and J. H. Wlosinski.
Technical Report E-83-15, October 1983. Final Report. 120 p, 39 Tab, 357 Ref.

Descriptors: *Data collections, *CE-QUAL-R1, *Computer programs, Algorithms, Reservoirs, Water quality, Respiration, Mortality, Decomposition.

This report supplies information about, and literature values for, many of the coefficients needed for the U.S. Army Corps of Engineers Reservoir Model, CE-QUAL-R1. Most of the information presented concerns biological processes of gross production, ingestion, respiration, mortality, and decomposition. Coefficients specified are suitable for the algorithms described in the Instruction Report E-82-1 entitled CE-QUAL-R1: A Numerical One-Dimensional Model of Reservoir Water Quality: User's Manual,' available from the Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss. (Author)
W86-00153

EFFECTS OF ACID RAIN ON SOIL AND WATER,

Connecticut Agricultural Experiment Station, New Haven.
For primary bibliographic entry see Field 2K.
W86-00166

POINT SOURCES-NONPOINT SOURCES TRADING IN THE LAKE DILLON WATERSHED.

Northwest Colorado Council of Governments, Frisco.
Final Report, 1984. 45 p.

Descriptors: *Nonpoint pollution sources, *Point pollution sources, *Trading, *Algae growth, *Advanced wastewater treatment, *Water pollution sources, Phosphorus, Eutrophication, Lake Dillon.

Lake Dillon is a highly valued water supply and recreational resource in north-central Colorado. Changing land uses and development in the basin have produced near-eutrophic algae growth in the lake. All wastewater treatment plants currently employ advanced wastewater treatment for phosphorus removal. Even with zero phosphorus discharge from treatment plants in the future, nonpoint phosphorus sources from growth areas would make the lake eutrophic. A phosphorus control plan for the lake was developed by local governments and adopted by the Colorado Water Quality Control Commission. The plan recommended that advanced wastewater treatment continue to be applied to all point sources. State-of-the-art nonpoint sources controls will be applied by local governments to all new development projects in the basin. An effluent trading system was developed to allow point sources growth beyond 1990. The trading system authorized by the State Commission allows dischargers to receive credit for cleaning up nonpoint sources which existed prior to 1984. A 2:1 ratio is used to account for uncertainties in the process. One pound of credit is assigned for each two pounds of preexisting nonpoint source phosphorus which is eliminated. This approach should keep phosphorus loading at 1982 levels. It allows local governments to control phosphorus in the most cost-effective manner without being limited only to further reductions on point sources. (Author)
W86-00167

FATE OF CHEMICALLY DISPERSED OIL IN THE SEA: A REPORT ON TWO FIELD EXPERIMENTS,

New Jersey Dept. of Environmental Protection, Trenton.
D. R. Green, J. Buckley, and B. Humphrey.
EPS 4-EC-82-5, December 1982. Environmental Protection Service, Ottawa (Ontario). 125 p, 42 Fig, 16 Tab, 8 Plates, 10 Ref.

Descriptors: *Oil Slicks, *Dispersants, Seawater, Oil Spills, Corexist 9527, Biodegradation.

Three liters of oil were spilled in each of two moored plastic enclosures (CEPEX enclosures) in Saanich Inlet, British Columbia. Corexit 9527 was used to disperse a portion of the surface slick in one enclosure while the other enclosure served as a control. The oil dispersion was stable during the two week period. The average droplet size was 1 micrometer or less. The dispersion of the oil resulted in a rate of biodegradation that is at least an order of magnitude higher than that for undispersed oil. Within 15 days, microbial oxidation of the alkane component of the oil was completed. Only 0.1% of the dispersed oil reached the sediments during the 15 day time period, and this oil was in an advanced state of bacterial decomposition. Loss of volatile components from dispersed oil was slower than from the surface slick. No detectable photochemical oxidation of the dispersed oil or the surface slick occurred during the experiment. Three experimental oil spills of 200, 400, and 200 liters were conducted in October 1978 at Royal Roads, British Columbia. The surface slicks were restrained with a Bennett inshore oil boom. The spilled oil was dispersed using Corexit 9527. The highest recorded concentration of dis-

persed oil was 1 ppm. After 30 min concentrations of 0.05 ppm were normal, decreasing to background within 5 hr. The dispersed oil did not mix deeper into the water column with time. The integrated quality of oil in the water column decreased more rapidly than either the mean oil concentration of the cloud or the maximum concentration. (Author's abstract, modified).
W86-00172

CHARACTERIZATION OF AEROBIC CHEMICAL PROCESSES IN RESERVOIRS: PROBLEM DESCRIPTION AND MODEL FORMULATION,

Camp, Dresser and McKee, Inc., Annandale, VA.
R. L. Chen, D. Gunnison, and J. M. Brannon.
Technical Report E-83-16, October 1983. Final Report. 87 p, 21 Fig, 9 Tab, 144 Ref.

Descriptors: *Mathematical models, *Dissolved oxygen, *Hydrologic models, *Rate models, Water quality control, Reservoirs, Stratification, Oxidation process, Aerobic conditions, Anaerobic conditions.

This report discusses oxidation pathways of chemicals and important environmental parameters that affect the transformation rate of selected nutrients and metals in lakes and reservoirs, and presents a model for predicting the transition from anaerobic to aerobic conditions. In order to better demonstrate the necessary components for an aerobic predictive model, consideration was given to the basic concepts of the most commonly available equilibrium models for predicting water quality in lakes. Evaluation of the practicality of available models revealed that, although equilibrium models provide the flexible and comprehensive approaches necessary for water quality prediction, rate models are more precise and reliable in their depiction of the transition from anoxic to aerobic conditions in reservoirs. Oxidation rates of selected nutrients and metals in U.S. Army Corps of Engineers reservoirs were determined in environmentally controlled laboratory investigations. Field measurements of the fate of reduced iron and manganese in the anoxic bottom water of Eau Galle Reservoir, Wisconsin, during destratification, corroborated the laboratory results. These oxidation rate coefficients will form the basic input variables for RE-AERS, a reaeration subroutine of the water quality evaluation model CE-QUAL-R1.
W86-00176

COMPUTER MODELING OF HYDRODYNAMICS AND SOLUTE TRANSPORT IN CANALS AND MARINAS: LITERATURE REVIEW AND GUIDELINES FOR FUTURE DEVELOPMENT,

National Board of Waters, Helsinki (Finland).
R. Walton.
Miscellaneous Paper EL-83-5, September 1983. Final Report. U.S. Army Environmental Impact Research Program, Army Engineer Waterways Experiment Station, Vicksburg, MS. 94 p, 45 Fig, 108 Ref.

Descriptors: *Canals, *Marinas, *Hydrodynamics, *Computer models, *Solute transport, Mathematical models, Literature review, Design criteria, Water quality, Physical properties, Model studies, Permits.

A literature review of modeling the hydrodynamics and solute transport processes in tidal canals and marinas is presented. Tidal prism analysis and one- and multi-dimensional models are described. By considering the three areas of physical processes, modeling, and design criteria, it is concluded that much still needs to be learned to enable the engineer to design such systems to meet a rational set of design criteria. In evaluating such proposed designs, the permitting agencies are in the same relative state of uncertainty as to what constitutes a 'good, environmentally acceptable' design. Future direction should include the selection of several varied existing canal and marina sites, and a program to study them to understand the fundamental physics and water quality processes involved. The next step should be to use this information to develop numerical models that can model the important processes observed, and a validation of their formulation. These models should be developed as engineering, as well as scientific, tools to allow easy use by practicing design engineers. A program of selective model and measurement sensitivity should be performed. These criteria should make sense to both the design engineer and the permitting agencies.
W86-00179

DISSOLVED METHANE CONCENTRATIONS IN THE SOUTHEAST BERING SEA, 1980 AND 1981,

Science and Education Administration, Fort Lauderdale, FL. Aquatic Plant Management Lab.
For primary bibliographic entry see Field 2K.
W86-00180

SORPTION BEHAVIOUR OF 14C IN GROUNDWATER/ROCK AND IN GROUNDWATER/CONCRETE ENVIRONMENTS,

Seakem Oceanography Ltd., Sidney (British Columbia).
B. Allard, B. Torstenfelt, and K. Andersson.
Report Prav 4.27, March 1981. 11 p, 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Fate of pollutants, *Water pollution prevention, *Radioactive wastes, *Carbon radioisotopes, *Sorption, Waste disposal, Underground waste disposal, Calcite, Concrete, Groundwater, Carbonates, Chemical precipitation, Moraine, Montmorillonite, Bentonite, Quartz, Granite, Rocks.

The sorption of carbon-14, present in radioactive waste from powerplants and nuclear fuel waste treatment, was studied in batch and column experiments on several solids. Although sorption of C14 was generally low, it increased with increasing calcium content of the solid. The order of increasing sorption on the solids was as follows: granite, sodium montmorillonite, sandy moraine < clayish moraine < bentonite/quartz (10/90) < calcite < concrete, cement paste. Calcite and sandy moraine were the only materials permeable enough for column tests. In experiments with calcite, the retention factor was 3 (C14 transport was up to 3 times slower than water). Higher retention is expected at lower groundwater flow due to the slow kinetics of sorption on calcite. It is expected that the retention factor for concrete and bentonite/quartz would be high enough for use as backfill materials in a radioactive waste repository. No C14 would leak from intact concrete. Even fractured concrete would retain most of the C14 by precipitation of carbonate.
W86-00184

USER GUIDE FOR LARM2: A LONGITUDINAL-VERTICAL, TIME-VARYING HYDRODYNAMIC RESERVOIR MODEL,

Edinger (J.E.) Associates, Inc., Wayne, PA.
E. M. Buchak, and J. E. Edinger.
Instruction Report E-82-3, December 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 91 p, 4 Fig, 4 Ref, 9 Append. Contract/Grant No. DACW39-78-C-0057.

Descriptors: *Fate of pollutants, *Lakes, *Reservoirs, *Water quality, *Model studies, Mathematical models, LARM2 model, Computer models, Hydrodynamics, Dillon Reservoir, Colorado.

LARM2 (laterally averaged reservoir model, version 2) has several improvements over the parent model, LARM. It incorporates a water quality transport module (WQTM) and the capability to add or delete upstream longitudinal segments during flooding or drawdown. This user's guide contains an overview of the model, a summary of its theoretical basis, a description of its application procedure, and an example, the Dillon Reservoir, Colorado. The appendixes include an input data description with examples and user notes for two auxiliary codes. LARM2 can be applied to a single, continuous reach of a river, lake, or reservoir. For $300 computer time, this model can be used for an eight-month simulation at a time step of 15 min for temperature and one other constituent on a grid that is 30 segments by 20 layers with 375 active cells. Estimates do not include intermediate simulations and postprocessing of results.
W86-00190

HYDROCARBONS ASSOCIATED WITH SUSPENDED MATTER IN THE GREEN RIVER, WASHINGTON,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
S. E. Hamilton, and J. D. Cline.
NOAA Technical Memorandum ERL PMEL-30, May 1981. 116 p, 20 Fig, 18 Tab, 1 Ill, 62 Ref, 3 Append.

Descriptors: *Fate of pollutants, *Hydrocarbons, *Rivers, *Suspended solids, *Wastewater treatment, Effluents, Green-Duwamish River, Washington, Aromatic hydrocarbons, Aliphatic hydrocarbons, Vegetation, Outfall, Wastewater outfall, Sediments, Organic compounds.

The suspended hydrocarbon composition in the Green-Duwamish River was defined seasonally and spatially, with special interest in the discharges from the Renton Secondary Treatment Plant. Above Auburn, Washington, the hydrocarbon mixture is dominated by odd-carbon paraffins derived from aquatic and terrestrial plants. In December the C15 and C17 alkanes associated with algae were at the lowest levels of the year. At the sewage outfall the proportion of odd- to even-carbon hydrocarbons decreased, reflecting the increase in even-carbon n-alkanes, pristane, and phytane. Concentrations of total alphatics, total aromatics, and an unresolved complex mixture increased with distance downriver. A hydrocarbon budget calculated for the lower river showed that heavy hydrocarbons were preferentially lost below the sewage outfall. Possible causes for this are (1) flocculation or desorption of suspended hydrocarbons as the effluent mixed with the river water and (2) incomplete recovery of material during analysis. Suspended matter in the river water contained these aromatics: retene, benz(e)pyrene, perylene, benz(g,h,i)perylene, chrysene, and fluoranthene at concentrations of 0.08-2.2 micrograms per gram dry weight. Levels of perylene and benz(g,h,i)perylene in the effluent were about 40 micrograms per gram. Esters of the even-carbon fatty acids associated with wastewater and higher plants were also found in these sediment samples.
W86-00196

WORKING PAPERS PREPARED AS BACKGROUND FOR TESTING FOR EFFECTS OF CHEMICALS ON ECOSYSTEMS.

National Research Council, Washington, DC. Committee to Review Methods for Ecotoxicology.
For primary bibliographic entry see Field 5C.
W86-00230

ECOTOXICOLOGY AT THE WATERSHED LEVEL,

Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
L. A. Norris.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 137-148, 9 Ref.

Descriptors: *Ecotoxicology, *Fate of pollutants, *Water pollution effects, *Organic compounds, *Aquatic habitats, Lakes, *Ecosystems, *Toxicology, Watersheds, *Environmental effects, Chemical properties, Heavy metals, Metals, Solubility, Vapor pressure, Stability.

Relatively few toxicological tests on the watershed (ecosystem) level have been done. Traditional techniques emphasize direct effects of chemicals on selected organisms. However, indirect effects are also important and may be far-reaching on the ecosystem level. For example, a chemical which reduces the primary productivity of an ecosystem may not directly affect organisms on higher troph-

ic levels, but the reduction in primary production may have an overwhelming effect. Other factors such as logging or tilling may interact with the chemicals of interest. Baseline values are necessary to determine the effects of natural processes such as carbon fixation by primary producers, energy transfers, nutrient cycling, and decomposition or organic substrates. Watershed pairing is desirable, but few are available for this purpose. Many factors affect the behavior of chemicals in the environment: properties of the chemical (water solubility, equilibrium vapor pressure, partition coefficient, and pH); and environmental properties (climatic, edaphic, topographic, and biotic). Chemicals of particular concern are heavy metals and substances with low water and high fat solubility, high equilibrium vapor pressure, high degree of stability, and high degree of mobility in soil.
W86-00234

UTILITY OF SINGLE SPECIES AND ECOSYSTEM TESTS IN ASSESSING THE ENVIRONMENTAL IMPACT OF RADIONUCLIDE ECOTOXICANTS,

Emory Univ., Atlanta, GA. Dept. of Biology.
H. L. Ragsdale.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 149-173, 61 Ref.

Descriptors: *Ecotoxicology, *Fate of pollutants, *Water pollution effects, *Radioactive wastes, *Aquatic habitats, *Ecosystems, *Aquatic life, *Environmental effects, *Toxicology, Single species tests, Radioisotopes, Microenvironment.

Single species or microcosm tests have a useful, but limited, role in defining radionuclear impacts on organisms. Some of the uses of single species testing include explaining phenomena observed at the ecosystem level, providing preliminary trials prior to large-scale ecosystem testing, studying in greater detail the specific mechanisms identified from ecosystem testing, developing a baseline of potential impact, developing predictive relationships between dose and response, and analyzing damage mechanisms. Ecosystem testing, however, provides comprehensive and conclusive knowledge of radionuclear ecotoxicant impacts which allows analysis of short-term and long-term impacts, provides data whose transferability to other systems and regions can be evaluated, allows extrapolation with maximum confidence, and allows explicit comparison of the severity of impact from a variety of ecotoxicants.
W86-00235

ECOSYSTEM APPROACH TO THE TOXICOLOGY OF RESIDUE FORMING XENOBIOTIC ORGANIC SUBSTANCES IN THE GREAT LAKES,

Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
W. R. Swain.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 193-257, 2 Fig, 18 Tab, 129 Ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Great Lakes, *Toxicology, *Ecosystems, *Aquatic habitats, *Pesticides, *Organochlorine pesticides, Insecticides, *Chlorinated hydrocarbons, Lakes, DDT, Polychlorinated biphenyls, Dieldrin, Lindane, Methoxychlor, Endosulfan, Benzene hexachloride, Plankton, Sediments, Lake sediments, Aldrin, Endrin, Heptachlor, Chlordane, Phthalates, Fish, Public health, Food chains.

A conceptual framework is presented for an ecosystem approach to the question of the impact of residue forming toxic substances of anthropogenic origin in the Great Lakes. This framework is an attempt to link a definite and orderly progression of events related to input sources of toxic substances and their compartmentalization phenomena. It is believed to be of utility because it considers interrelationships and properties between separate entities, incorporates defined criteria, and utilizes a series of linkages into which quantifiable values and numerically precise data can be inserted to enable an adequate mechanism for understanding the fate, transport and effects of toxic organochlorine compounds. Given the magnitude of the Great Lakes ecosystem in both spatial and temporal scales, the interdependency of the various ecosystem compartments and the multiplicity of exogenous substances with differing chemical/biological reactions, it is difficult to conceive that any other approach to the question could adequately address the complexity of the issue. While short term laboratory tests are useful in delineating areas of the environment where problems can be anticipated, often the question of scale makes direct translation of results to the Great Lakes difficult, if not impossible. The approach described in this effort is an attempt to overcome these difficulties for toxic xenobiotic organochlorine compounds. (Author)
W86-00237

LEACHATE FROM HAZARDOUS WASTES SITES,

New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
P. N. Cheremisinoff, and K. A. Gigliello.
Technomic Publishing Co., Inc., Lancaster, PA. 1983. 88 p.

Descriptors: *Water pollution sources, *Fate of pollutants, *Leachates, *Landfills, *Water disposal, Solid waste disposal, Sampling, Monitoring, Wells, Model studies, Pollutant identification, Linings, Plastics, Water pollution control, Wastewater treatment, Water pollution effects, Groundwater pollution, Damage.

This report is a guide to the formation, generation, sampling methodology, control, and treatment of leachate from solid waste sites. Four types of disposal sites are defined--dump, landfill, sanitary landfill, and secured landfill. The mechanisms for contamination of groundwater by leachates are described. The processes of infiltration, percolation, evaporation, and transpiration are involved in leachate generation. Leachate characteristics vary from site to site. The volume depends on the soil's absorptive capacity, areal extent, composition, placement, cover material and operation, and amount of recharge water available for infiltration. The water balance method may be used to estimate leachate generation. Sampling considerations and methods are given for seeps, wells, and leachate collection systems. Laboratory methods applicable to leachate assessment include modeling techniques, shake tests, saturation tests, column tests, and field test cells. Effects of leachate on lining materials are summarized. Among leachate control methods are proper selection of waste, control of water movement, control of decay, lining with leachate collection, leachate treatment, natural renovation, incineration, aeration, leachate recycle, and integrated treatment systems. Leachate damage, usually contamination of wells, and case histories are described.
W86-00247

STREAM WATER QUALITY IN THE COAL REGION OF ALABAMA AND GEORGIA,

Northeastern Forest Experiment Station, Broomall, PA.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-1246363. General Technical Report NE-73, 1982. 109 p, 34 Fig, 65 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, Alabama, Georgia, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 58 small streams in 12 counties of Alabama and 3 in Dade County, Georgia, are given for the period July 19, 1977, to August 10, 1979. Twenty of the watersheds were unmined. Thirty-eight of the watersheds had been surface mined, some recently (after 1972) some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.
W86-00250

STREAM WATER QUALITY IN THE COAL REGION OF WEST VIRGINIA AND MARYLAND,

Northeastern Forest Experiment Station, Berea, KY.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118182. General Technical Report NE-70, 1982. 215 p, 71 Fig, 131 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, West Virginia, Maryland, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 118 small streams in 27 counties of West Virginia and nine streams in two counties of western Maryland are given for the period June 9, 1977, to November 9, 1979. Forty-eight of the watersheds were unmined. Seventy-nine of the watersheds had been surface mined, some recently (after 1972) and some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.
W86-00253

ARCTIC MARINE OILSPILL PROGRAM (AMOP) REMOTE SENSING STUDY,

Canada Centre for Remote Sensing, Ottawa (Ontario).
For primary bibliographic entry see Field 7B.
W86-00258

MATHEMATICAL MODEL, SERATRA, FOR SEDIMENT-CONTAMINANT TRANSPORT IN RIVERS AND ITS APPLICATION TO PESTICIDE TRANSPORT IN FOUR MILE AND WOLF CREEKS IN IOWA.

Battelle Pacific Northwest Labs., Richland, WA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-122671. EPA 600/3-82-045, August 1982. Environmental Research Laboratory, Athens, GA. 56 p, 24 Fig, 1 Tab, 26 Ref. Contract/Grant No. 68-03-2613.

Descriptors: *Fate of pollutants, *Model studies, *Sediment transport, *Pesticides, *Streams, *Water quality, SERATRA model, Degradation, Biodegradation, Volatility, Hydrolysis, Oxidation, Photolysis, Particulate matter, Finite element method, Four Mile Creek, Wolf Creek, Iowa, Mathematical models, Bottom sediment, Alachlor, Sedimentation.

The sediment-contaminant transport model SERATRA was used as an integral part of the Chemical Migration and Risk Assessment Methodology, which simulates migration and fate of a contaminant over the land surface and in receiving streams, to assess potential short- and long-term impact on aquatic biota. SERATRA, an unsteady, two-dimensional (longitudinal and vertical) finite element model, consists of three submodels coupled to include the effects of sediment-contaminant interactions--a sediment transport submodel, a dissolved contaminant transport submodel, and a particulate contaminant (contaminants adsorbed by sediment) transport submodel. The sediment transport submodel simulates transport, deposition, and scouring of three sediment size fractions of cohesive and noncohesive sediments. The dissolved contaminant transport submodel includes mechanisms of contaminant adsorption/desorption and

contaminant degradation resulting from hydrolysis, oxidation, photolysis, volatilization, biological activities and radionuclide decay to predict migration of dissolved contaminant. The particulate contaminant submodel simulates transport, deposition and scouring of contaminants associated with three size fractions of sediments. SERATRA also predicts changes of bed conditions for sediment and particulate contaminants. (Author)
W86-00259

PLANNING GUIDE FOR EVALUATING AGRICULTURAL NONPOINT SOURCE WATER QUALITY CONTROLS,

Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5G.
W86-00260

STREAM WATER QUALITY IN THE COAL REGION OF OHIO,

Northeastern Forest Experiment Station, Broomall, PA.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119495. General Technical Report NE-75, 1982. 138 p, 46 Fig, 73 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, Ohio, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 70 small streams in 19 counties of Ohio are given for the period June 1, 1977, to October 4, 1979. Nineteen of the watersheds were unmined. Fifty of the watersheds had been surface mined, some recently (after 1972) and some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.
W86-00267

STREAM WATER QUALITY IN THE COAL REGION OF PENNSYLVANIA,

Northeastern Forest Experiment Station, Broomall, PA.
K. L. Dyer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124586. General Technical Report NE-76, 1982. 168 p, 61 Fig, 88 Tab, 8 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality, *Streams, *Coal mining, Strip mines, Watersheds, Pennsylvania, Appalachia, Small watersheds, Forest watersheds.

Water quality data for 86 small streams in 23 counties of Pennsylvania are given for the period July 13, 1977, to October 4, 1979. Twenty-nine of the watersheds were unmined. Fifty-seven of the watersheds had been surface mined, some recently (after 1972) and some mined before 1972. Data included are bicarbonate, carbonate, chloride, sulfate, alkalinity, acidity, pH, specific conductance, 16 trace elements, ammonia, nitrate, nitrate plus nitrite, total nitrogen, phosphorus, orthophosphate, water temperature, suspended solids, turbidity, settleable matter, and estimated discharge. The interpretation of the data will be presented in a later report covering nine states in the Appalachian area.
W86-00281

SURVEY OF POLYCHLORINATED BIPHENYLS IN INDUSTRIAL EFFLUENTS IN CANADA.

Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
Report EPS 3-WP-81-1, March 1981. 19 p, 5 Tab, 26 Ref.

Descriptors: *Water pollution sources, *Fate of pollutants, *Polychlorinated biphenyls, *Organic compounds, *Industrial wastewater, Pulp and paper industry, Aluminum, Paint industry, Chemical industry, Chlorinated hydrocarbons, Canada.

Polychlorinated biphenyls (PCBs) in industrial effluents and process streams in Canada were sampled in two phases: (1) an overall survey involving 308 samples in 31 types of industries and (2) sampling of 45 effluents from 7 selected plants discharging significant quantities of PCBs. Of the 308 samples from general industry, 48 contained more than 0.1 ppb PCB. These industries were pulp and paper, smelting, paint manufacturing, electrical equipment manufacturing, chemicals, sewage treatment, aviation, iron and steel, petrochemicals, mining, poultry packing, waste oil recycling, food products, machine shop, and coal superport. A pulp and paper mill using recycled paper discharged effluents with 28.0-48.2 ppb PCB. Other plants and the PCB concentrations (ppb) of their effluents were aluminum smelting, 0.11-3.94; paint manufacturing, 0.24-4.66; petrochemicals, 0.42; and chemical manufacturing, 5.1. Likely sources of PCB in the effluents were recycled waste paper, hydraulic fluids, paint pigments, and electrical oils. PCBs, probably with 4 or less chlorine atoms per molecule, may be formed inadvertently by some plant processes (chlorination of waste biphenyls in wastewater treatment or synthesis from certain aromatic compounds). However, none were detected in this study, which did not use analytical methods designed to detect lower-chlorine PCBs.
W86-00286

USE OF SATELLITE IMAGERY FOR TRACKING THE KURDISTAN OIL SPILL,

Remotec Applications Ltd., St. John's (Newfoundland).
For primary bibliographic entry see Field 7B.
W86-00291

EFFECTS, PATHWAYS, PROCESSES, AND TRANSFORMATION OF PUGET SOUND CONTAMINANTS OF CONCERN,

E.V.S. Consultants Ltd., North Vancouver (British Columbia).
D. E. Konasewich, P. M. Chapman, E. Gerencher, G. Vigers, and N. Treloar.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-118208. NOAA Technical Memorandum OMPA-20, July 1982. National Oceanic and Atmospheric Administration, Boulder, CO. 357 p, 35 Fig, 37 Tab, 765 Ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Estuaries, Sediments, *Toxicity, *Organic compounds, Benthos, *Puget Sound, Chlorinated hydrocarbons, Polyaromatic hydrocarbons, Naphthalene, Benzo(a)anthracene, Fluoranthenes, Benzo(a)pyrene, Arsenic, Cadmium, Heavy metals, DDT, Insecticides, Pesticides, Polychlorinated biphenyls, Hexachlorobenzene, Phthalates, Copper, Lead, Mercury, Selenium, Silver, Aquatic life, Inorganic compounds, Bioaccumulation, Biodegradation, Water pollution sources.

Toxicity and distribution data on the 183 organic compounds and 37 inorganic ions identified in Puget Sound sediments, biota, and waters were reviewed. The chemicals were classified into six categories based on degree of concern for the environment. The 15 contaminants or classes of contaminants of greatest concern were polychlorinated dibenzofurans and chlorophenol precursors, chlorinated butadienes, polyaromatic hydrocarbons and halogenated derivatives, arsenic, cadmium, DDT and metabolites, polychlorinated biphenyls, hexachlorobenzene and related compounds, chlorinated ethylenes, phthalates, copper, lead, mercury, selenium, and silver. The study concluded that concentrations of many contaminants were higher in the Puget Sound ecosystems than in other areas of the world. Four research needs were identified: (1) develop and implement a surveillance plan to assess trends and fate and effects of pollutants (2) develop an ecological hazard assessment scheme, (3) establish the relationship between levels of contaminants in sediments and benthic biota and the consequent toxic effects of these levels on biota, and (4) develop additional basic information on the behavior and fate of chemicals in the marine and estuarine environments.
W86-00293

EUROPEAN AND UNITED STATES CASE STUDIES IN APPLICATION OF THE CREAMS MODEL.

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
IIASA Collaborative Proceedings Series CP-82-S11, 1982. Edited by V. Svetlosanov and W. G. Knisel. 148 p.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, *Mathematical models, CREAMS model.

CREAMS (Chemicals, Runoff, and Erosion from Agricultural Management Systems), a mathematical model for determining nonpoint source pollution, has three components: hydrology, erosion/sedimentation, and chemistry (nutrients and pesticides). Part I describes the model and shows how it is applied. Parts II and III concern case studies in several European countries: Finland, Germany, Poland, Sweden, United Kingdom, and Lithuania (USSR). Part IV looks at the future, CREAMS2, which will incorporate the knowledge obtained in this study. Part V summarizes the basic conclusions. Among the conclusions are (1) CREAMS generally gives good representations of the hydrology, erosion/sediment yield, and chemical processes. It needs revision and addition of certain processes (snowmelt, frozen soil, organic fertilizer, etc.) specific to European conditions. CREAMS is useful for evaluating alternate management alternatives but does not predict absolute quantities. CREAMS should be calibrated when data become available. Although it is a field-scale model, it may be a foundation or a component of regional or larger watershed studies. CREAMS2, an improved and more comprehensive model, will also include soil temperature, snowmelt/frozen soil, nitrogen cycling, vertical flux of pesticides, and a totally linked model structure to simplify process interactions and model feedback.
W86-00294

CREAMS: A SYSTEM FOR EVALUATING MANAGEMENT PRACTICES ON FIELD-SIZE AREAS,

Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
W. G. Knisel, G. R. Foster, M. H. Frere, R. A. Leonard, and A. D. Nicks.
In: European and United States Case Studies in Application of the CREAM Model, IIASA Collaborative Proceedings Series CP-82-S11, 1982. p 7-40, 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Fate of pollutants, *Water pollution sources, *Water quality control, *Model studies, *Hydrology, *Erosion, *Sediment yield, Pesticides, *Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, *Mathematical models, Fertilizers, Leaching, CREAMS model.

CREAMS (Chemicals, Runoff, and Erosion from Agricultural Management Systems) is a field-scale mathematical model for assessing nonpoint source pollution and evaluating alternate practices for controlling pollution from sediments and chemicals. CREAMS consists of three major components: hydrology, erosion/sedimentation, and chemistry. The hydrology component estimates storm runoff by either of two options, depending on availability of rainfall data: (1) with daily rainfall data and (2) by an infiltration-based method. The erosion component considers the basic processes of soil detachment, transport, and deposition. The chemistry component concerns plant nutrients and pesticides. An example shows the application

of CREAMS to a 3.2-acre field in the Georgia Piedmont area.
W86-00295

TESTING THE APPLICATION OF CREAMS TO FINNISH CONDITIONS,

National Board of Waters, Helsinki (Finland).
L. Kauppi.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Col- laborative Proceedings Series CP-82-S11, 1982. p 43-47, 2 Tab, 3 Ref.

Descriptors: •Fate of pollutants, •Water pollution sources, •Water quality control, •Model studies, •Hydrology, •Erosion, •Sediment yield, Pesti- cides, •Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agri- cultural chemicals, Fertilizers, Leaching, •Mathe- matical models, Hovi Basin, •Finland, CREAMS model.

The CREAMS model was applied to the agricultural Hovi basin in Finland. The area under study used the open ditch drainage system. Yearly runoff plus percolation in 1968 was 265 mm (calculated 288 mm) and in 1969 was 223 mm (calculated 229 mm). The daily response lagged by a day because of the ditch system. Soil losses were calculated from the model and from suspended solids concen- trations in runoff waters. In 1968 soil loss (in tons per sq km) was 110 (from model) and 14 (from suspended sediments). In 1969 soil loss (in tons per sq km) was 88 (from model) and 24 (from suspended sediments). Nitrogen and phosphorus losses cal- culated by the model were significantly greater than those calculated from concentrations and runoff observations, particularly in autumn. The model needs modifications to adapt well to Finnish conditions. These considerations include a snow- melt component and further work on calibration and selection of appropriate parameter values.
W86-00296

ENVIRONMENTAL EFFECTS OF NITROGEN FERTILIZATION EXEMPLIFIED BY GROUNDWATER POLLUTION AS SIMULATED BY CREAMS,

Goettingen Univ. (Germany, F.R.).
S. Stemmler.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Col- laborative Proceedings Series CP-82-S11, 1982. p 49-62, 5 Fig, 3 Tab, 16 Ref.

Descriptors: •Fate of pollutants, •Water pollution sources, •Water quality control, •Model studies, •Hydrology, •Erosion, •Nonpoint pollution sources, Agricultural hydrology, Nutrients, Nitro- gen, Agricultural chemicals, •Mathematical models, Fertilizers, Nitrates, Mussum water re- serve, Germany, Leaching, CREAMS model.

The CREAMS model was tested in the Mussum water reserve area of northwestern Germany. In the hydrology submodel the first runs underesti- mated percolation (120-180 mm calculated, 300 mm actual) and overestimated evapotranspiration. Changes in the program and equations produced good results in later runs. Nitrate was the only chemical considered in the study. It was possible to quantify the relation between fertilization intensity (up to 480 kg N per ha) of arable land and nitrate concentrations in the water percolated below the root zone. However, results were applicable only to the thin and uniformly distributed aquifers in the study area.
W86-00297

APPLICATION OF THE CREAMS MODEL FOR CALCULATION OF LEACHING OF NITRATE FROM LIGHT SOILS IN THE NOTEC RIVER VALLEY,

Institute for Land Reclamation and Grassland Farming, Raszyn (Poland).
A. Sapek.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Col- laborative Proceedings Series CP-82-S11, 1982. p 63-70, 5 Tab, 1 Ref.

Descriptors: •Fate of pollutants, •Water pollution sources, •Water quality control, •Model studies, •Hydrology, •Nonpoint pollution sources, Agri- cultural hydrology, Nutrients, Nitrates, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, •Mathematical models, Notec River Valley, Poland, CREAMS model, Denitrification.

The CREAMS model was used for calculation of the amount of leached nitrate below the plant root zone and of the nitrogen balance in light soil with average physical properties occurring in the Notec River valley, Poland. The simulation was per- formed with the precipitation data for the period 1960-1979. The calculated nitrate leaching aver- aged about 25 kg N per hectare per year, which constitutes a threat for the water quality and fertil- izer economy. Higher nitrogen losses from soil were due to the denitrification process. The largest amounts of nitrate leached and percolation oc- curred in the autumn-winter months. It seems that the most feasible method of verification of the reliability of model output would be the measure- ment of the content of nitrate in soil after and before the growing season. (Author)
W86-00298

APPLICATION OF THE CREAMS MODEL: WESTERN SKANE, SWEDEN,

Lund Univ. (Sweden). Dept. of Water Resources Engineering.
L. DeMare.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Col- laborative Proceedings Series CP-82-S11, 1982. p 71-82, 4 Fig, 2 Tab, 11 Ref.

Descriptors: •Fate of pollutants, •Water pollution sources, •Water quality control, •Model studies, •Hydrology, •Nonpoint pollution sources, Agri- cultural hydrology, Nutrients, Nitrates, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, •Mathematical models, Skane, Sweden, Potatoes, Wheat, CREAMS model.

The hydrology and nutrient components of the CREAMS model were used to evaluate the nitrate leaching from agricultural fields in Skane, at the southern tip of Sweden. Annual leaching amounts corresponded fairly well to results obtained from field experiments. However, CREAMS should not be used to predict absolute quantities. In particular, a small error in estimating percolation in summer causes large errors in leaching output. The model proved useful for comparing nitrate leaching pro- duced from several management practices: pota- toes with rain and rain/irrigation; wheat with rain and rain/irrigation.
W86-00299

PREDICTING HILLSLOPE RUNOFF AND EROSION IN THE UNITED KINGDOM: PRELIMINARY TRIALS WITH THE CREAMS MODEL,

National Coll. of Agricultural Engineering, Silsoe (England).
R. P. C. Morgan, and D. D. V. Morgan.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Col- laborative Proceedings Series CP-82-S11, 1982. p 83-97, 4 Tab, 15 Ref.

Descriptors: •Fate of pollutants, •Water pollution sources, •Water quality control, •Model studies, •Hydrology, •Erosion, •Sediment yield, •Non- point pollution sources, Agricultural hydrology, •Mathematical models, Silsoe, United Kingdom, Runoff, Slopes, CREAMS model.

Promising results are obtained when the CREAMS model is applied to soil losses in the Silsoe area, United Kingdom. Soil loss predictions are reasona- ble under these conditions: (1) the concept of chan- nel erosion is extended to include convergences of flow within the overland flow whenever sediment concentrations exceed a critical threshold and (2) observed runoff depths from unbounded plots are calculated with the 1-sq m strategy. The hydrolo- gy submodel shows promise as a runoff predictor if the observed runoff is calculated with the 10-sq m strategy. The 10-sq m strategy involves converting the observed runoff volumes to an average depth over 10 sq m; the 1-sq m strategy does the same over a 1-sq m area.
W86-00300

APPLICATION OF THE CREAMS MODEL AS PART OF AN OVERALL SYSTEM FOR OPTIMIZING ENVIRONMENTAL MANAGEMENT IN LITHUANIA, USSR: FIRST EXPERIMENTS,

Lithuanian Research Inst. of Forestry, Vilnius (USSR).
L. Kairiukstis, and G. Golubev.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Col- laborative Proceedings Series CP-82-S11, 1982. p 99-119, 9 Fig, 3 Tab, 5 Ref.

Descriptors: •Fate of pollutants, •Water pollution sources, •Water quality control, •Model studies, •Hydrology, •Erosion, •Sediment yield, •Non- point pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agricultural chemicals, Fertilizers, Leaching, •Mathematical models, Lithuania, Forests, CREAMS model.

First experiments with the CREAMS model show that it is suitable for predicting hydrology, erosion, and nutrient transport for the conditions in Lithua- nia. However, it will be necessary to modify the model to compensate for the long, stable snow cover, the high groundwater level, and the proc- esses associated with snowmelt. Although CREAMS was developed for agricultural land, it shows promise for use in forested lands.
W86-00301

REVIEW OF CASE STUDIES OF CREAMS MODEL APPLICATION,

Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
W. G. Knisel, and V. Svetlosanov.
In: European and United States Case Studies in Application of the CREAMS Model, IIASA Col- laborative Proceedings Series CP-82-S11, 1982. p 123-135, 1 Fig, 2 Tab, 9 Ref.

Descriptors: •Fate of pollutants, •Water pollution sources, •Water quality control, •Model studies, •Hydrology, •Erosion, •Sediment yield, Pesti- cides, •Nonpoint pollution sources, Agricultural hydrology, Nutrients, Phosphorus, Nitrogen, Agri- cultural chemicals, Fertilizers, Leaching, •Mathe- matical models, Czechoslovakia, Germany, Fin- land, Lithuania, Poland, Sweden, United King- dom, CREAMS model.

The applicaton of the CREAMS model in these case studies (Czechoslovakia, Germany, Finland, Lithuania, Poland, Sweden, and United Kingdom) have resulted in identification of model limitations and areas which call for improvements. Also, they have shown that CREAMS gives generally good results, and the model is a tool that can be used to aid in development of agricultural management practices for nonpoint source pollution control. Validation with observed data has shown that CREAMS is a suitable model for extrapolating research results to other climatic and soil regions. Although the model gives reasonable results in simulation, it is desirable to calibrate it with data where possible. (Author)
W86-00302

ETHYLENE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.

Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W86-00303

5C. Effects Of Pollution

RAPIDITY OF RNA SYNTHESIS IN HUMAN CELLS; A HIGHLY SENSITIVE PARAMETER FOR WATER CYTOTOXICITY EVALUATION,

Service de Controle des Eaux de la Ville de Paris (France).

For primary bibliographic entry see Field 5A.
W86-00052

WASTEWATER REUSE AND EXPOSURE TO LEGIONELLA ORGANISMS,

Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
B. Fattal, H. Bercovier, M. Derai-Cochin, and H. I. Shuval.
Water Research, Vol. 19, No. 6, p 693-696, 1985. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Wastewater reuse, *Legionella, *Bacteria, *Public health, Wastewater disposal, Human physiology, Water pollution effects, Fish ponds.

Eight hundred and fifty-two (852) blood sera were drawn in 1980 and 1981 from populations residing in 30 agricultural settlements (having a total population of 16,240). These sera were tested for the presence of antibodies against 15 different antigens of Legionella species (L. pneumophila serogroups 1-8 and seven other Legionella, i.e. bozemanii, gormanii, micdadei, jordanis, dumoffi, longbeacheae and oakridgensis). The results indicate a significant ($P < 0.02$) excess in the percentage of sera positive for L. pneumophila (serogroups 1-8) among sewage and non-sewage irrigation and fish pond workers as compared to the control group (4.5% vs 1.5%). For the other Legionella species, there was no difference among the above groups. The isolation of L. pneumophila serogroup 4 and five organisms resembling Legionella spp from one oxidation pond used for irrigation strengthens the seroepidemiological findings. (Author's abstract)
W86-00054

PASSAGE OF SELECTED HEAVY METALS FROM SPHAEROTILUS (BACTERIA: CHLAMYDOBACTERIALES) TO PARAMECIUM CAUDATUM (PROTOZOA: CILIATA),

Middle Tennessee State Univ., Murfreesboro.
M. Mansouri-Aliabadi, and R. E. Sharp.
Water Research, Vol. 19, No. 6, p 697-699, 1985. 2 Tab, 18 Ref.

Descriptors: *Heavy metals, *Sphaerotilus, *Paramecium, *Bacteria, *Bioconcentration, Metals, Protozoa, Bioaccumulation, Zinc, Lead, Manganese, Nickel, Water pollution effects.

The ability of ciliates to purify turbid activated-sludge effluents has been suggested to be the result of predation upon bacteria and flocculation of living and non-living suspended matter. One factor which brings about the absence or reduction in number of ciliated protozoa in activated sludge is the introduction of toxic metals, often as by-products of industrial processes. The possibility that passage of heavy metals occurs from bacteria to protozoa was investigated. Paramecium caudatum protozoans were freed from their associated bacteria and thrived on Sphaerotilus, a bacterium occurring in polluted waters, as their only food source. Sphaerotilus was found to take up Zn, Pb, Ni and Mn; metal-containing cultures of this bacterium were employed to feed P. caudatum, and analytical results revealed the accumulation of Zn, Pb and Ni. The bacteria did not pass Mn to the animals at all even though uptake of Mn by Spaerotilus was relatively high when compared with other metals used in this study. No metals were found in control cultures of paramecia. Since Sphaerotilus was the only food source for paramecia during this study, the results indicate that trace amounts of metals were passed from bacteria to protozoa in a predator-prey relationship. (Collier-IVI)
W86-00055

HEAVY METAL ACCUMULATION (CD, CU, PB AND ZN) BY SMELT (OSMERUS MORDAX) FROM THE NORTH SHORE OF THE ST LAWRENCE ESTUARY (ACCUMULATION DE QUELQUES METAUX LOURDS (CD, CU, PB ET ZN) CHEZ L'EPERLAN (OSMERUS MORDAX) PRELEVE SUR LA RIVE NORD DE L'ESTUAIRE DU SAINT-LAURENT),

Quebec Univ., Rimouski. Dept. of Oceanography.
M. Arnac, and C. Lassus.
Water Research, Vol. 19, No. 6, p 725-734, 1985. 4 Fig, 3 Tab, 29 Ref.

Descriptors: *Heavy metals, *Bioaccumulation, *Smelt, *Fish, *St. Lawrence Estuary, *Cadmium, *Copper, *Zinc, *Lead, Metals, Fish physiology, Water pollution effects, Animal tissues, Animal physiology.

A method of physiologically removing metals in marine organisms is by storage in a particular tissue. Several different sites for storing metals were investigated and concentrations of Cd, Cu, Pb and Zn were examined in muscle, liver and gonads of smelt (Osmerus mordax) from the North shore of the St. Lawrence estuary. A modified wet digestion procedure was used to prepare biological samples for the determination of trace elements by flameless atomic absorption spectrophotometry procedure, using calibration standards made up in a matrix of similar acidity. NBS bovine liver reference material was analyzed along with the samples; results were within the specified tolerance. Analyses were reported on a dry weight basis. Copper (range 0.3-3.3 micro-g/g) and zinc (range 19-38 micro-g/g) in muscle fillets were found to be negatively correlated with total body weight. Livers and gonads contained greater levels of the four metals than somatic muscle. Liver metal concentrations of Zn (range 29-108 micro-g/g) and Cd (range 0.06-0.37 micro-g/g) increased with total body weight. All equations fit data at $P < 0.01$. Positive correlations between size and metal concentrations suggest that net uptake may occur. Increasing metal concentrations in liver may represent storage of sequestered products in that organ. In the gonads, no significant relationship exists between total body weight and trace metal contents. Females had significantly greater Cu and Zn concentrations, but no significant difference existed between males and females for Cd concentrations. The relation between concentration and total body weight appears to be specific as to the species, tissues analyzed and environmental conditions. The comparison of metal concentrations in fish to assess variations in contamination levels requires understanding the relationship between metal concentration and body size within each population. (Collier-IVI)
W86-00059

TOXICITY TO DAPHNIA OF THE END PRODUCTS OF WET OXIDATION OF PHENOL AND SUBSTITUTED PHENOLS,

Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W86-00064

WATER-QUALITY APPRAISAL, MAMMOTH CREEK AND HOT CREEK, MONO COUNTY, CALIFORNIA,

Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-00106

PRELIMINARY EVALUATION OF LAKE SUSCEPTIBILITY TO WATER-QUALITY DEGRADATION BY RECREATIONAL USE, ALPINE LAKES WILDERNESS AREA, WASHINGTON,

Geological Survey, Seattle, WA. Water Resources Div.
R. J. Gilliom, P. Dethier, S. A. Safioles, and P. L. Heller.
USGS Water-Resources Investigation Open-File Report 80-1124, 1980. 1 p, (map and text), 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Water quality, *Water pollution control, *Recreation planning, *Wilderness lakes, *Land use, Nutrients, Phosphorus, Pathogens, Maps, *Washington, Alpine Lakes Wilderness Area, *Alpine Lakes.

The relative susceptibility of lakes in the Alpine Lakes Wilderness Area to water-quality degradation was evaluated from two perspectives: (1) water-quality sensitivity, which is the tendency of a lake's water quality to degrade in response to pollutant loading, and (2) pollutant-loading likelihood, which is determined by the presence of drainage-basin features that enhance the transport of pollutants to a lake. Water-quality sensitivity was evaluated for 60 lakes, using a mass-balance phosphorus model to predict the response of each lake to a hypothetical 'worst-case' increase in phosphorus loading. This evaluation suggested that lakes in the Alpine Lakes Wilderness Area generally are not sensitive to foreseeable increases in phosphorus loading because of their high rate of dilution and flushing. Pollutant-loading likelihood was evaluated according to the amount of seasonal 'wet area' near a lake and in the drainage basin. Of 298 lakes evaluated for pollutant-loading likelihood, 74 lakes were rated moderate to high. On the basis of these findings, lakes in the Alpine Lakes Wilderness Area are generally not considered susceptible to long-term degradation as a result of recreational use, but some lakes are probably susceptible to temporary local pollution. The nature of this potential problem, and knowledge of natural features of the Alpine Lakes Wilderness Area, suggest an approach for managing recreation so that the risk of water-quality degradation is minimized. (USGS)
W86-00114

RESULTS OF AN ADAPTIVE ENVIRONMENTAL ASSESSMENT MODELING WORKSHOP-CONCERNING POTENTIAL IMPACTS OF DRILLING MUDS AND CUTTINGS ON THE MARINE ENVIRONMENT,

Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
G. T. Auble, A. K. Andrews, R. A. Ellison, D. B. Hamilton, and R. A. Johnson.
Available from the National Technical Information Service, Springfield, VA 22161, as PB83-114165. Environmental Research Laboratory, Gulf Breeze, FL. EPA-600/9-82-019. October 1982. 64 p. 33 Fig, 6 Tab, 14 Ref, 1 Append. Contract/Grant No. EPA-81-D-X0581.

Descriptors: *Drilling fluids, *Environmental effects, *Marine environment, Drilling cuttings, Bays, Drilling, Drilling mud, Gulf of Mexico.

This publication summarizes the findings of a workshop held September 14-18, 1981 between the United States Environmental Protection Agency and the United States Fish and Wildlife Service. Discussions focused on information pertaining to fate and effects, identification of general relationships between drilling mud fluids and the marine environment, and identification of site-specific variables likely to determine impacts of drilling muds and cuttings in various marine sites. The workshop was structured around the construction of a model simulating fate and effects of discharges from a single rig into open waters of the Gulf of Mexico. Factors that might produce different fate and effects in enclosed areas such as bays and estuaries also were discussed. Considerable knowledge (such as that concerning fate and physical effects of dredge spoil) that could be effectively employed in analysis of potential fate and physical effects in enclosed areas was identified.
W86-00147

LABORATORY PROTOCOLS FOR EVALUATING THE FATE OF ORGANIC CHEMICALS IN AIR AND WATER,

SRI International, Menlo Park, CA.
For primary bibliographic entry see Field 5A.
W86-00154

LONG-TERM IMPACT OF DREDGED MATERIAL AT TWO OPEN-WATER SITES: LAKE ERIE AND ELLIOT BAY; EVALUATIVE SUMMARY,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. E. Tatem.
Technical Report D-84-5, November 1984. Final Report. 37 p, 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Dredging, *Lake Erie, *Water pollution effects, *Solid waste disposal, *Ecological effects, Polychlorinated biphenyls, Microorganisms, Mollusks, Polychaetes, Benthos, Waste disposal, Water pollution.

Dredged material disposal sites in Lake Erie and Elliott Bay were studied in 1979-1980 and results were compared with those obtained in 1975-1976 from studies at the same sites. The Lake Erie disposal sites contained more gravel and sand than control areas. In general the microfaunal animals were less abundant at the Lake Erie disposal sites which were richer in meiofauna. No differences in Hg or Cd levels were found between disposal and control sites. The disposal mound created in 1975-1976 in Elliott Bay had stabilized physically and chemically. The mound area contained more animals than the surrqunding bottom areas. Bivalves and polychaetes were the dominant animals found at the Elliott Bay disposal site. Some animals taken from the disposal mound contained polychlorinated biphenyls at levels slightly higher than sediment levels which were in the 2.0- to 3.0-ppm range.
W86-00160

LONG-TERM IMPACT OF DREDGED MATERIAL DISPOSAL IN LAKE ERIE OFF ASHTABULA, OHIO,

Weston (Roy F.), Inc., West Chester, PA.
K. J. Salamon.
Technical Report D-84-3, September 1984. Final Report. Army Engineer Waterways Experiment Station, Vicksburg, MS. 123 p, 41 Fig, 15 Tab, 40 Ref, 6 Append. Contract/Grant No. DACW39-79-C-0060.

Descriptors: *Dredging, *Sediment disposal, *Sediments, *Benthic fauna, *Ecological effects, *Heavy metals, Benthos, Aquatic animals, Mercury, Cadmium, *Dredging spoil, Bioaccumulation, Silt, Sand.

Animal, sediment, and water samples obtained from three Lake Erie disposal sites containing material dredged from Ashtabula Harbor were analyzed for sediment characteristics, benthic animals and Hg and Cd levels. Results were compared with those of two nearby reference areas and with results of studies conducted in 1975 and 1976. Disposal sites contained more gravel and sand than the reference sites which were predominantly silt and clay. A number of macrofauna and meiofauna benthic animals were found at both disposal and reference areas. In general, more macrofaunal animals and a greater variety of species were found at the reference areas. Only the macrofauna were statistically more abundant at the reference areas. Sediment analyses showed the reference or control areas contained higher levels of Hg compered to the disposal areas. For Cd the opposite was true. There were higher Cd levels at the disposal areas. The differences in metal concentrations at disposal and reference sites were not statistically significant. Tissue analyses showed that animals at the reference areas contained higher levels of Hg and Cd compared to disposal area animals.
W86-00162

VOLUNTEER LAKE MONITORING, 1981,

Illinois State Environmental Protection Agency, Springfield. Div. of Water Pollution Control.
D. F. Sefton, and J. R. Little.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-119180. Report No. IEPA/WPC/82-006, June 1982. 138 p, 20 Fig, 6 Tab, 28 Ref, 4 Append.

Descriptors: *Lakes, *Water pollution effects, *Monitoring, *Limnology, *Transparency, *Water quality, Illinois, Eutrophication, Stratification, Thermal stratification, Trophic level, Data acquisition, Glacial lakes, Lake morphology, Reservoirs, Lake classification, Aquatic life, Aquatic plants, Aquatic animals, Algae, Ecosystems, Food chains, Photosynthesis, Respiration, Lake stages, Water pollution sources, Water quality control, Septic tanks.

This report summarizes the methods and results of the Illinois EPA 1981 volunteer lake monitoring program. Secchi disc transparency, total depth, and field observations were recorded by 141 volunteers monitoring 87 lakes. Lakes ranged in transparency from 137.9 inches (Arbor in DuPage County) to 7.3 inches (Royal in Calhoun County). The clearest lakes were generally in the northwestern and southern part of the state; the most turbid, in the central and southcentral regions. Average transparencies of less than 4 ft (minimum recommended for bathing beaches) were reported in 63 of the 87 lakes. About 1/3 of the lakes had average values less than 2 ft, indicating use impairment problems. None of the monitored lakes were classified oligotrophic, 9 were mesotrophic, and the remainder were eutrophic. A primer of basic information on Illinois lakes for the layman is given. This includes origin, shape, hydrology, ecosystems, thermal stratification, succession and eutrophication, pollution, and water quality control measures.
W86-00200

METHODS FOR ECOLOGICAL TOXICOLOGY: A CRITICAL REVIEW OF LABORATORY MULTISPECIES TESTS.

Oak Ridge National Lab., TN. Environmental Sciences Div.
Ann Arbor Science, Ann Arbor, MI. 1981. Edited by Anna S. Hammons. 307 p.

Descriptors: *Water pollution effects, *Toxicology, *Chemical wastes, Ecological effects, Environmental effects, Aquatic habitats, Aquatic plants, Algae, Predation, Fish, Sediments, Zooplankton, Parasites, Population dynamics, Ecosystems, Mathematical models, Model studies, Invertebrates, Predation, Microorganisms, Arthropods, Insects, Soil, Litter, Animals, Plants, Mycorrhizae.

Selected laboratory methods for measuring ecological effects of toxic substances were critically evaluated. Criteria used in the evaluation were whether or not the tests were rapid, reproducible, relatively inexpensive, unequivocal, sensitive, socially relevant, predictive, generalizable, and well-developed. Tests recommended for research and development were as follows: in aquatic test systems--zooplankton-zooplankton predation tests, fish-zooplankton predation tests, parasitism, zooplankton-algal grazing tests, pelagic microcosms, and model streams; in terrestrial test systems--population interactions and ecosystems; and mathematical models--ecosystem paramater handbook, model validation methods, theoretical studies (multipopulation models, loop analysis, input-ouput analysis).
W86-00210

SURVEY OF NATIONAL AND STATE REGULATORY AGENCY POLICY AND PROCEDURES FOR THE DETERMINATION OF THE TOXICITY OF WASTEWATER EFFLUENTS.

Ecological Analysts, Inc., Sparks, MD.
For primary bibliographic entry see Field 6E.
W86-00211

LONG-TERM ECOLOGICAL BEHAVIOUR OF ABANDONED URANIUM MILL TAILINGS; 2.: GROWTH PATTERNS OF INDIGENOUS VEGETATION ON TERRESTRIAL AND SEMI-AQUATIC AREAS,

Toronto Univ. (Ontario). Inst. for Environmental Studies.
K. Kalin.
Report EPS 3/HA/2, December 1984. 98 p, 29 Fig, 17 Tab, 62 Ref.

Descriptors: *Water pollution effects, *Mine wastes, *Vegetation, *Uranium mill tailings, Spoil banks, Industrial wastes, Acid mine drainage, Trees, Cattails, Aquatic plants, Growth, Wetlands, Plant populations, Aspen trees, Birch trees.

The effect of abandoned or inactive uranium mill tailings on natural vegetation was studied in Ontario. Cattails have invaded the semi-aquatic areas. All communities were essentially monocultures of Typha latifolia, T. angustifolia, or T. glauca. Sedges, wool grass, and reed grass were found in transition zones between the cattails and the dry tailings. Cattail growth appeared to depend on the hydrological conditions, rather than on the chemical nature of the tailings. The root zones were less acidic than the soil surface. Decomposition coefficients of the cattail stands were comparable to those in control stands. Trees, mainly trembling aspens and white birch, have colonized the uranium tailings. Tree heights were similar regardless of site treatment (fertilizer and limestone application). However, when compared with trees in control sites, the trees appeared stunted and growing at their limits of ecological tolerance.
W86-00217

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN: ECONOMIC AND SOCIAL IMPACTS OF GROUNDWATER CONTAMINATION; A CASE STUDY IN EAST BAY TOWNSHIP, GRAND TRAVERSE COUNTY, MICHIGAN.

Northwest Michigan Regional Planning and Development Commission, Traverse City.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132670. MI/DNR/GW-82/07, June 1982. 22 p. EPA Grant P00558801.

Descriptors: *Water pollution effects, *Groundwater pollution, *Water quality, *Water supply, Social impact, Economic impact, East Bay Township, Grand Traverse County, Michigan, Municipal water, Groundwater management, Local governments, Organic compounds, Attitudes, Public opinion, Water costs, Wells.

The social and economic impacts of groundwater contamination in East Bay Township, Grand Traverse County, Michigan, were surveyed in the Avenue E area where city water service was extended to potentially 102 homes. Contamination consisted of several toxic chemicals, which produced strong odor and foaming in the water supply. Most residents were retired or older working persons for whom additional expenses could significantly impact their budgets. The residents' perceptions of and reactions to their well water contamination were closely associated with what they could see or understand about water quality. All residents coped with the problems with varying degrees of hardship. The largest economic factor was the city water hookup. However, most residents had enough funds set aside for such an emergency. The contamination affected property values, a fact that most residents did not perceive. The most common social impact was lack of water. Other social impacts were frustration over the lack of information and over the water rate negotiations. All residents wanted the responsibility for the contamination resolved as a step toward cost reimbursement. In general the property owners' confidence in the government agencies involved in the problem did not diminish. The township government incurred costs of $13,200; the additional work was a major burden for the small staff.
W86-00218

WORKING PAPERS PREPARED AS BACKGROUND FOR TESTING FOR EFFECTS OF CHEMICALS ON ECOSYSTEMS.

National Research Council, Washington, DC. Committee to Review Methods for Ecotoxicology.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132811. National Academy Press, Washington, DC. 1981. 257 p.

Descriptors: *Water pollution effects, *Fate of pollutants, Lakes, *Ecosystems, Toxicology, *Aquati habitats, *Aquatic animals, *Environmental effect Microenvironment, *Toxic wastes, *Ecotoxicology.

The eleven working papers in this volume we
prepared for the study of the committee to Revie
Methods for Ecotoxicology. The charge to th
Committee was to identify characteristics of ec
logical systems that would indicate hazardous
fects of chemicals beyond the level of single sp
cies, to establish criteria for suitable testi
schemes, and to evaluate the effectiveness of ava
able test systems in assessing effects of chemic
within ecosystems. To assist in its deliberations

the broad range of issues to be addressed, the Committee sought additional input from a number of experts. The working papers address a variety of topics: the use of microcosms as a testing scheme in terrestrial and aquatic systems; lethal gene distribution and diatoms as monitoring techniques for hazard assessment of chemicals in ecosystems; special problems associated with hazard assessment of wetlands and watersheds; approaches to assessing the environmental impact of radionuclide and xenobiotic organic substances; a general review of ecosystem properties relevent to ecotoxicology; and a discussion of the advantages and disadvantages of various classes of ecological tests. (Author)
W86-00230

LAKES AND MICROCOSMS: EXTENDING MICROCOSM DATA TO AQUATIC ECOSYSTEMS,

California Univ., Berkeley. Lawrence Berkeley Lab.
P. H. Gleick.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 18-49, 76 Ref.

Descriptors: *Water pollution effects, *Lakes, *Aquatic habitats, *Ecosystems, *Microcosms, *Aquatic animals, Temperature, Nutrients, Fish, Plankton, Water quality, Transparency, Phosphorus, Biomass, Turbidity, Fish food, Phytoplankton, Algae, Oxygen depletion, Predation, *Microenvironment.

Microcosms can be used to determine the effects of toxic materials on aquatic ecosystems. One limitation of microcosms is the difficulty in accurately modeling certain important ecosystem parameters such as fish productivity, water transparency, odor, and disease vectors. These macrovariables are often influenced by microvariables (temperature, composition and productivity of plankton communities, water composition, and microbial decomposition activity). By analyzing in microcosms the effects of perturbations on microvariables, and by using field data on the correlations between these micro- and macrovariables, it is possible to deduce data on how a macrovariable may react to a given environmental perturbation. Among the most promising correlations are phosphorus levels with fish yields and transparency, total dissolved solids with standing crop of fish, and chemical concentration (e.g., ammonia) levels with oxygen depletion and fish kills.
W86-00231

OPTIMUM MICROCOSMS FOR LAKE ECOTOXICOLOGY,

California Univ., Berkeley. Lawrence Berkeley Lab.
J. Harte.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 51-69, 16 Ref.

Descriptors: *Water pollution effects, *Lakes, *Aquatic habitats, *Ecosystems, *Microcosms, *Aquatic animals, *Toxicology, Gnotobiotic initiation, Whole-water-sample initiation, Surface growth, Biomass, Turbidity, Fish food, Phytoplankton, Algae, Oxygen depletion, Predation, Ecotoxicology, Microenvironment.

Many options are available for the design, initiation, and operation of lake-like microcosms. The choices selected will have a large influence on the realism of the results of ecotoxicological studies conducted with these microcosm. Hydraulically closed systems, initiated by the whole-water-sample method, and periodically poured into clean containers to prevent surface growth will behave most like the parent lake with respect to both chemical and biotic parameters. It is also likely that such systems will provide the most realistic information about the pathways and effects of toxic substances. Replicability is often poor when organisms are initially present in small numbers. Generally, no added replicability or realism is obtained by increasing the complexity and expense of the microcosm. For example, whole-water-sample initiation is easier than gnotobiotic initiation, closed systems are simpler than chemostats, and surface growth control by periodic pouring is easier than other means. However, this does not apply to incorporation of a benthic compartment in a microcosm.
W86-00232

CHEMICALS AND WETLANDS,

R. H. Kadlec.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-132811.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 97-118, 42 Ref.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Wetlands, *Chemicals, *Aquatic habitats, Water quality, Advanced wastewater treatment, Microbial degradation, Biodegradation, Biological wastewater treatment, Buffering, Nutrients, Nitrogen, Phosphorus, Aquatic plants, Heavy metals, Bottom sediments, Organic compounds, Halogenated hydrocarbons, Hydrocarbons, Biochemical oxygen demand, Chemical oxygen demand, Pathogens, Bacteria, Coliforms, Viruses.

Wetlands have certain characteristics which must be considered during an environmental assessment of toxic chemicals on the ecosystem. Wetlands appear to have a buffering systems (with respect to pH, alkalinity, and hardness), which tends to maintain a stationary operating point under natural and man-made stress. Water quality varies with time (diurnal, seasonal, historical) and water flow distance. The hydrologic regime must be fully understood the understand the variation of chemical parameters. Sediment is the site of action for most uptakes and initial storages of chemicals. Uptake by plants and subsequent return to the sediment often takes many months, while epiphytes perform similarly, but on a time scale of hours. Nitrogen and phosphorus show a cyclic behavior, and microbial processes are very important in nutrient uptake processes. Heavy metals are absorbed aquatic plants and sediments, with more entering the sediments in most wetlands. Refractory chemicals such as hydrocarbons or halogenated hydrocarbons are often slowly degraded by microbial processes. Advanced wastewater treatment using wetlands usually has excellent BOD and COD reduction. The fate of viruses and bacteria in wastewater applied to wetlands has been studied with variable results.
W86-00233

ECOTOXICOLOGY AT THE WATERSHED LEVEL,

Pacific Northwest Forest and Range Experiment Station, Corvallis, OR. Forestry Sciences Lab.
For primary bibliographic entry see Field 5B.
W86-00234

UTILITY OF SINGLE SPECIES AND ECOSYSTEM TESTS IN ASSESSING THE ENVIRONMENTAL IMPACT OF RADIONUCLIDE ECOTOXICANTS,

Emory Univ., Atlanta, GA. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W86-00235

CLASSES OF ECOTOXICOLOGICAL TESTS: THEIR ADVANTAGES AND DISADVANTAGES FOR REGULATION,

California Univ., Berkeley. Lawrence Berkeley Lab.
R. A. Schneider.
In: Working Papers Prepared as Background for Testing for Effects of Chemicals on Ecosystems, National Academy Press, Washington, DC. 1981. p 175-191, 24 Ref.

Descriptors: *Water pollution effects, *Aquatic habitats, *Microcosms, *Ecosystems, *Toxicology, Single species tests, *Environmental effects, Field tests, *Ecotoxicology, Microenvironment,.

Three classes of ecotoxicological tests, single-species, microcosm, and field tests, are discussed and evaluated for their usefulness in toxic substance regulation. Criteria for evaluation are ability to predict ecosystem-level effects, replicability, standardizability, speed, simplicity, and cost. The major conclusion is that microcosms of intermediate complexity and small field plots are presently the most useful tools for ecotoxicological testing and hazard evaluation. (Author)
W86-00236

ECOSYSTEM APPROACH TO THE TOXICOLOGY OF RESIDUE FORMING XENOBIOTIC ORGANIC SUBSTANCES IN THE GREAT LAKES,

Environmental Research Lab.-Duluth, Grosse Ile, MI. Large Lakes Research Station.
For primary bibliographic entry see Field 5B.
W86-00237

RESTORATION OF HABITATS IMPACTED BY OIL SPILLS.

Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr. 182 p.

Descriptors: *Oil spills, *Ecological effects, *Oil pollution, Symposium, *Water pollution effects, *Water pollution control, *Cleanup operations, Tidal flats, Salt marshes, Coral reefs, Mangrove swamps, Beaches, Shores, Sea grasses, Tundra, Habitats, Fisheries, Environmental impact statement, Conferences, Ecosystems.

This book presents reports of a workshop held at the Virginia Polytechnic Institute and State University on November 9-11, 1981. The workshop convened scientists from various backgrounds to review the problem of oil spills and determine courses of action that may include possible means for restoration of impacted habitats. Seven chapters authored by different scientists cover the following topics: recovery and restoration of rocky shores, sandy beaches, tidal flats, and shallow subtidal bottoms impacted by oil spills; the effects of oil on seagrass ecosystems; the recovery and restoration of salt marshes and mangroves following an oil spill; measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil; oil spill damage and recovery in tundra and taiga; fisheries resource impacts from spills of oil or hazardous subtances; and a workshop summary.
W86-00239

RECOVERY AND RESTORATION OF ROCKY SHORES, SANDY BEACHES, TIDAL FLATS, AND SHALLOW SUBTIDAL BOTTOMS IMPACTED BY OIL SPILLS,

Stockholm Univ. (Sweden). Dept. of Zoology.
B. Ganning, D. J. Reish, and D. Straughan.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 7-36, 5 Fig, 5 Tab, 96 Ref.

Descriptors: *Oil spills, *Oil pollution, *Cleanup operations, *Ecological effects, *Literature reviews, *Water pollution effects, Aquatic organisms, *Littoral environments, Tidal flats, Shores, Environmental effects, Intertidal areas, Beaches.

A review of the literature on oil spills on rocky shores shows that the intertidal organisms in this type of environment exhibit considerable tolerance to oil pollution. Most damage from oil coating leads to suffocation or loss of attachment to the substrate. On sandy intertidal shores of tidal flats, the impact is increased by the persistence of oil in unconsolidated substrates. In subtidal sediment bottoms, the sensitivity to oil pollution is greater than in shallow sediment habitats since the organisms are living in fairly stable environments. Oil spill impact and effects of cleanup operations are more closely related to seawater temperatures than to latitude. Areas with large tidal amplitude suffer less from oil pollution than do low tidal or nontidal areas. Seasonality affects the impact of oil spills, especially when the spill takes place after reproduction and hatching. Areas having salinities dif-

fering from those of normal seawater suffer more stress when subjected to oil pollution due to increased inherent physiological stresses. For rocky shores, cleanup of oils by natural recovery processes is usually recommended. If mechanical removal of oil-contaminated sand is not feasible, then the polluted area should be left to natural recovery methods. Disposal of materials from cleanup operations is best done at oil refineries.
W86-00240

EFFECTS OF OIL ON SEAGRASS ECOSYSTEMS,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. C. Zieman, R. Orth, R. C. Phillips, G. Thayer, and A. Thorhaug.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 37-64, 5 Fig, 1 Tab, 82 Ref.

Descriptors: *Sea grasses, *Aquatic plants, *Ecosystems, *Oil spills, *Oil pollution, *Ecological effects, *Water pollution effects, *Cleanup operations, Fouling, Littoral zones, Environmental effects, Habitats, Dispersants, Toxicity, Intertidal areas, Literature reviews.

A review of seagrass ecology is given to facilitate a discussion of the effects of oil spills on one of the most productive ecosystems known. Physically, seagrasses prevent erosion and stabilize the effects of tidal actions and provide habitats for numerous epiphytic organisms. Biologically, seagrasses perform an essential cycling of nutrients by absorbing P through the roots and leaves and returning both N and P to the water column from sediments via the plant. Seagrass ecosystems can be damaged by oil through direct suffocation or fouling of organisms or destruction of food sources or habitats. Oil pollution can affect the food market value of seagrass fisheries by tainting of flavor. Studies in the literature of major oil spills indicate that the greatest damage to aquatic organisms seems to be from aromatic hydrocarbon fractions of oil. The effects of oil dispersants on seagrass communities are not known. Inert absorbents present little hazard to seagrass systems if properly used. The normal recovery of seagrass systems from oiling depends on the extent of damage to sediments. Efforts of restoring oil-damaged seagrass systems by transplanting plugs or shoots have met with variable success. It is suggested that research be carried out on the toxicity levels of the major hydrocarbon substances on the major seagrass species in laboratory and field tests.
W86-00241

RECOVERY AND RESTORATION OF SALT MARSHES AND MANGROVES FOLLOWING AN OIL SPILL,

Research Planning Inst., Inc., Columbia, SC.
C. D. Getter, G. Cintron, B. Dicks, R. R. Lewis, and E. D. Seneca.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 65-113, 7 Fig, 4 Tab, 121 Ref.

Descriptors: *Mangrove swamps, *Marshes, *Oil spills, *Oil pollution, *Ecological effects, *Water pollution effects, *Cleanup operations, *Literature reviews, Wetlands, Dispersants, Ecosystems, Marsh plants, Swamps, Environmental effects.

Oil impacts to marshes will vary with amount of oil spilled, oil type, magnitude of cleanup activities, physical and biological structure of the marsh, latitude and season. Persistence of damage and recovery of the system depend on physical, chemical, and biotic factors such as weathering rate and degree of oil removal, availability of propagules, successional processes, sediment erosion/accretion, and restorative activities by man. Mangrove forests have different reactions to oil pollution, depending on mangrove types. Basin forests are already subjected to high natural stresses and may be more sensitive to additional stresses. If mangrove overwash islands are isolated from normal waves, they can be more severely damaged by the stranding of oil in them. Most protective techniques are unlikely to damage marsh ecosystems, but the effects of oil-dispersant mixtures are not known. Foot and equipment traffic during cleanup of oil spills may produce adverse effects on marshes but not usually on mangroves. Techniques for restoring oiled marsh and mangrove areas include transplanting, fertilization, direct seeding, planting of propagules, seedlings or small trees. Research gaps include the effects of dispersants and herding compounds on marshes and mangroves, evaluation of cleanup techniques, studies on animal species of marshes and mangroves, follow-up studies of spill sites, growth of plants on oiled substrates and experimental restoration techniques.
W86-00242

MEASUREMENTS OF DAMAGE, RECOVERY, AND REHABILITATION OF CORAL REEFS EXPOSED TO OIL,

Continental Shelf Associates, Inc., Boulder, CO.
K. W. Fucik, T. J. Bright, and K. S. Goodman.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 115-133, 3 Fig, 2 Tab, 62 Ref.

Descriptors: *Coral reefs, *Oil spills, *Corals, *Oil pollution, *Dispersants, *Water pollution effects, *Ecological effects, *Cleanup operations, Environmental effects, Coelenterates, Oil recovery, Ecosystems, Oil.

The Arabian Gulf and the Greater Caribbean are two well developed coral reef areas that receive much petroleum activity through the traffic of oil transporting tankers. Prespill mapping of coral reefs, a technique useful in the prevention and cleanup of oil spills, has been applied only to some reef areas. The sensitivity of reef ecosystems to oil spills is increased if the reef is of the emergent of shallow submergent type. Mechanized techniques such as skimmers do not cause oil to become incorporated into the water column. Currently available dispersants produce temporary stress reactions in corals in laboratory tests. Particulate sinking agents should be avoided in the cleanup of oil spills near coral reefs. To assess the damage and recovery of coral reefs to oil pollution, studies at the organismal level should be conducted before community level impacts are examined. Difficulty arises in assessing the recovery of reefs from oil spills because little data exists for comparative purposes and recovery is a long term process. Reef rehabilitation may by transplanting coral planulae. More field studies are needed on the recovery after oil spills of complex coral reef systems.
W86-00243

FISHERIES RESOURCE IMPACTS FROM SPILLS OF OIL OR HAZARDOUS SUBSTANCES,

Environmental Research Lab., Gulf Breeze, FL.
W. P. Davis, D. E. Hoss, G. I. Scott, and P. F. Sheridan.
In: Restoration of Habitats Impacted by Oil Spills, Butterworth, Boston. 1984. Edited by John Cairns, Jr. and Arthur L. Buikema, Jr., p 157-172, 1 Tab, 37 Ref.

Descriptors: *Oil spills, *Fisheries, *Environmental impact statement, *Oil pollution, *Water pollution effects, *Ecological effects, *Marine fisheries, *Economic aspects, Environmental effects, Fish, Toxicity, Oil, Fish stocking, Aromatic compounds, Cleanup operations, Shellfish.

Studies have shown that, in general, refined petroleum products are more toxic than crude oils to marine organisms. The toxicity of aromatic hydrocarbons increases with increasing molecular size. To protect identified fisheries from oil spills, shellfish may be harvested in 'fenced off' areas or be transferred to safer areas prior to contamination. Attempts to obtain comparative assessments of impacts on fisheries have been made during a number of oil spills by using such techniques as echo sounding, species counting, aerial observations, and grid sampling methods. In Japan, the help of fishermen was enlisted when oil threatened a major fishery. All catches were carefully monitored for contamination and economic damages were calculated. Population restoration after oil spills can be accomplished by restocking. Areas that require further study are the relation of species or population stress to actual impact, use of dispersants, determination of recovery times, measurement techniques for sublethal effects and continued monitoring of spill areas to evaluate effectiveness of restoration efforts.
W86-00244

EFFECTS, PATHWAYS, PROCESSES, AND TRANSFORMATION OF PUGET SOUND CONTAMINANTS OF CONCERN,

E.V.S. Consultants Ltd., North Vancouver (British Columbia).
For primary bibliographic entry see Field 5B.
W86-00293

ETHYLENE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.

Environmental Protection Service, Ottawa (Ontario).
August 1984. 58 p, 15 Fig, 6 Tab, 137 Ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Ethylene, *Hydrocarbons, *Chemical spills, *Spills, *Aquatic life, *Toxicity, *Water pollution prevention, Transportation, Lakes, Fishkill, Environmental effects, Pollutant identification, Chemical properties, Physical properties

Information useful for designing countermeasures for ethylene spills and for assessing their effects on the environment includes a summary of pertinent data, chemical and physical properties, production and transportation, fate in the environment, toxicity to aquatic life and other organisms, suggested countermeasures, and analytical methods. When spilled into water, liquid ethylene simultaneously vaporizes and spreads on the surface. It is relatively insoluble in water. Nomograms are given for calculating rate of spreading on still water. The 4-day medium lethal toxicity rating for aquatic life is 1000 to 100 mg per liter. A fishkill is reported in fresh water at a concentration of 22-252 mg per liter and exposure of 1 hr. Ethylene disperses rapidly without bioaccumulation or food chain contamination potential. If necessary, ethylene-contaminated water may be aerated. Since chlorination in the presence of ethylene can form dichloroethane, drinking water contaminated with ethylene should be aerated before chlorination.
W86-00303

5D. Waste Treatment Processes

EFFECTS ON GROUNDWATER QUALITY OF THE INTRODUCTION OF SECONDARY SEWAGE TREATMENT TO AN EFFLUENT RECHARGE SITE ON THE CHALK OF SOUTHERN ENGLAND,

Water Research Centre. Marlow (England).
K. M. Baxter.
Journal of Hydrology, Vol. 77, p 333-359, 1985. 8
Fig, 7 Tab, 16 Ref. Commission of the European
Commmunities contract ENV-399-UK(N).

Descriptors: *Groundwater contamination, *Sec
ondary wastewater treatment, *Artificial recharge
*England, *Chalk aquifer, Wastewater disposal
Wastewater treatment, Effluent, Recharge, Fate o
pollutants.

Detailed investigations were carried out at a si
on the Chalk of southern England between 197
and 1982 to determine the effects of sewage effl
ent recharge on groundwater quality. Before 19
screened crude domestic sewage was recharged
the Chalk via a series of lagoons. During 1981
secondary-treatment works was commissioned
the site and the effluent recharged through a ne
subsurface drain network. Monitoring of the in
ganic, organic and microbiological quality of eff
ent and groundwater continued through
change-over, enabling the effects of the n
regime to be assessed. The recharge of sewa
effluent to groundwater was shown to be an eff

tive way of ameliorating the effluent quality. Following the introduction of secondary treatment at the site there seems to have been little change in the degree of contaminant removal. (Author's abstract)
W86-00043

WASTEWATER REUSE AND EXPOSURE TO LEGIONELLA ORGANISMS,

Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5C.
W86-00054

TOXIC ORGANICS REMOVAL KINETICS IN OVERLAND FLOW LAND TREATMENT,

Cold Regions Research and Engineering Lab., Hanover, NH.
T. F. Jenkins, D. C. Leggett, L. V. Parker, and J. L. Oliphant.
Water Research, Vol. 19, No. 6, p 707-718, 1985. 4 Fig, 11 Tab, 32 Ref.

Descriptors: *Toxic substances, *Organic compounds, *Wastewater treatment, *Land treatment, *Overland flow, Water treatment, Volatilization, Adsorption, Sorption.

The efficiency in removing 13 trace organics from wastewater was studied on an outdoor, prototype overland flow land treatment system. More than 94% of each substance was removed at an application rate of 0.4 cm/h (0.12 cu m/h/m of width). The % removals declined as application rates were increased. Removal from solution was described by first-order kinetics. A model based on the two-film theory was developed using three properties of each substance (the Henry's constant, the octanol-water partition coefficient and the molecular weight) and two system parameters (average water depth and residence time). The dependence of the removal process on temperature was consistent with the known dependence of Henry's constant and diffusivity on temperature. The model was tested on a second overland flow system. (Author's abstract)
W86-00057

COMPUTER SIMULATION OF AN INDUSTRIAL WASTEWATER TREATMENT PROCESS,

Montana Coll. of Mineral Science and Technology, Butte. Dept. of Chemistry and Geochemistry.
D. R. Jenke, and F. E. Diebold.
Water Research, Vol. 19, No. 6, p 719-724, 1985. 1 Fig, 6 Tab, 7 Ref. U.S. Bureau of Mines grant J0295042.

Descriptors: *Computer models, *Wastewater treatment, *Industrial wastewater, Mixing, Lime, Acid mine drainage, Mine drainage, Acid streams, Chemical reactions.

The computer program REDEQL.EPAK has been modified to allow for the prediction and simulation of the chemical effect of mixing two or more aqueous solutions and one or more solid phases. In this form the program is capable of modelling the lime neutralization treatment process for acid mine waters. In its present form, the program calculates the speciation of all influent solutions, evaluates the equilibrium composition of any mixed solution and provides the stoichiometry of the liquid and solid phases produced as a result of the mixing. The program is used to predict the optimum treatment effluent composition, to determine the amount of neutralizing agent (lime) required to produce this optimum composition and to provide information which defines the mechanism controlling the treatment process. (Author's abstract)
W86-00058

TOXICITY TO DAPHNIA OF THE END PRODUCTS OF WET OXIDATION OF PHENOL AND SUBSTITUTED PHENOLS,

Michigan Technological Univ., Houghton. Dept. of Biological Sciences.
R. Keen, and C. R. Baillod.
Water Research, Vol. 19, No. 6, p 767-772, 1985. 6 Fig, 5 Tab, 12 Ref. EPA grant R805565-010.

Descriptors: *Toxicity, *Daphnia, *Water pollution effects, *Wet oxidation, *Phenols, Wastewater treatment, Oxidation, Bioassays, Water treatment.

The process of wet oxidation breaks down organic substances in aqueous solution at elevated temperatures and pressures. Experimental wet oxidations were carried out on pure solutions of phenol, 2-chlorophenol and 4-nitrophenol. After 1-h wet oxidation, final concentrations of these compounds averaged 3% of their concentrations in the starting solutions. The toxicities of the starting compounds and the residual toxicity of the end-product solutions were measured with 48-h acute toxicity tests using Daphnia magna. The solutions of end products were all less toxic than the starting solutions by factors ranging from 10 to 120. However, the end-product solutions were somewhat more toxic than would be predicted from the known concentration of initial compound remaining in the solution of end products. (Author's abstract)
W86-00064

POINT SOURCES-NONPOINT SOURCES TRADING IN THE LAKE DILLON WATERSHED,

Northwest Colorado Council of Governments, Frisco.
For primary bibliographic entry see Field 5B.
W86-00167

DEPOSIT CONTROL TECHNOLOGY FOR KRAFT RECOVERY UNITS,

New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
H. N. Tran.
Environmental Protection Service, Ottawa, Ontario. Report EPS 3/PF/1, December 1984. 26 p, 21 Fig, 2 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Pulp and paper industry, *Kraft mills, *Pulp wastes, Bleaching wastes, Waste recovery, Automation, Monitoring, Economic aspects, Models.

This report describes the development of an online instrument for measuring the rate of accumulation of fireside deposits in the superheater and boiler sections of kraft recovery units. The recovery unit eliminates the lignin and other wood components dissolved in the black liquor and recovers and regenerates the inorganic pulping chemicals while producing steam for power generation and process heating. Large accumulations of fireside deposits plug flue gas passages and ultimately limit kraft recovery unit capacity and pulp mill production. Sootprobe offers the opportunity for increased pulp production through improved deposit control. It is estimated that, in a nominal 750-ton/day kraft mill, the use of this technology would result in an incremental pulp production of $26 million/yr, and an energy savings of $200 thousand. Results of three trials of the research models of sootprobe at a kraft mill in Ontario show that the accumulation of deposits in the superheater and boiler bank regions in kraft recovery units can be continuously measured using sootprobe. The signal from sootprobe is reliable. Sootprobe can be used to monitor flue gas temperatures. Deposit accumulation rates in the superheater and boiler bank regions vary significantly at the same black liquor firing load. Sootprobe provides a feedback signal to the operator so that he can adjust firing conditions to minimize deposit accumulation rate.
W86-00170

ENVIRONMENTAL ENGINEERING,

Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W86-00188

FLOW BALANCING METHOD FOR STORMWATER AND COMBINED SEWER OVERFLOW,

Swedish Council for Building Research, Stockholm.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124453. 1982. 27 p, 8 Fig, 5 Photos.

Descriptors: *Wastewater treatment, *Flow control, *Equalizing, *Lake restoration, *Storm wastewater, *Combined sewer overflows, Peak flow, Varied flow, Water pollution control, Runoff, Storm runoff, Overflow.

A low-cost flow balancing plant for storm water discharges and combined sewer overflows was demonstrated at Lake Trehorningen near Stockholm, Sweden. Floating tanks consisting of pontoons with reinforced vertically hanging plastic curtains are anchored to the bottom of the receiving water body. They operate as a horizontally working balancing system using the plug flow principle. The surrounding water functions as a balancing medium. When storm water discharge exceeds the pumping capacity of the treatment plant, the polluted storm water pushes the lake water from one floating tank compartment to the next in the flow direction. When storm water discharge is less than the pumping capacity of the treatment plant, the flow is reversed, allowing lake water to successively enter the floating tank compartments. During dry weather lake water may be pumped through the treatment plant to improve water quality. Experiences at three similar installations are described.
W86-00191

DEVELOPMENT DOCUMENT FOR EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE TEXTILE MILLS POINT SOURCE CATEGORY,

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
For primary bibliographic entry see Field 5G.
W86-00207

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, AUGUST, 1981-OCTOBER, 1982: CITATIONS FROM THE NTIS DATA BASE,

National Technical Information Service, Springfield, VA.
Available from the National Technical Information Sevice, Springfield, VA 22161 as PB83-801365. December 1982. 183 p.

Descriptors: *Mine wastes, *Bibliographies, *Oil shale, *Industrial wastes, *Wastewater treatment, *Water pollution control. *Water quality control, Gasification, Pollutant identification, Leachates, Shales, Environmental effects, Ecological effects, Groundwater pollution, Streams, Water requirements.

This bibliography contains 183 abstracts of government-funded research on oil shale. Among the water-related subjects are water pollution control, waste and wastewater characterization and treatment, leachates, effect on groundwater and stream water quality, environmental and ecological impacts of wastes, water requirements, social and economic impacts, and hydrological aspects. All these entries are new since the last edition.
W86-00215

NEW CONCEPTS AND PRACTICES IN ACTIVATED SLUDGE PROCESS CONTROL,

Arthur Technology, Inc., Fond du Lac, WI.
R. M. Arthur.
Activated Sludge Process Control Series, Ann Arbor Science, Ann Arbor, MI. 1982. 125 p.

Descriptors: *Wastewater treatment, *Activated sludge, *Biological wastewater treatment, *Monitoring, *Process control, *Activated sludge process, *Aeration, *Mixed liquor solids, Sludge, Suspended solids, Denitrification, Control systems, Systems engineering.

Process control in the wastewater treatment plant is the responsibility of the plant operator. The engineer aids the plant operator in his job by

designing a plant which has the flexibility and controllability needed to produce high quality effluents. On-line instrumentation provides the basis for process control. In conventional plug flow activated sludge plant, aeration, return of settled sludge, and mixed liquor suspended solids are controllable elements. Conventional activated sludge systems can be modified by contact stabilization, extended aeration, and use of pure oxygen. Control methods may be manual or of the microprocessor, computer control or adaptive control types. Control modes available are on-off controls, ratio control, proportional control, proportional plus integral control, and proportional plus derivative control. The four measurements of the biological system important in process control include progress of metabolism, the state of denitrification, the concentration of viable microorganisms and the aerobic-anaerobic stage of respiration. The sensors that are available to monitor these factors are discussed along with various control schemes for the activated sludge process.
W86-00221

CHEMICALS AND WETLANDS,

For primary bibliographic entry see Field 5C.
W86-00233

MODELING OF AN ANFLOW MUNICIPAL WASTE-TREATMENT UNIT,

Massachusetts Inst. of Tech., Oak Ridge, TN. School of Chemical Engineering Practice.
D. J. Halbert, and R. J. Wojtowicz.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-16617. ORNL/MIT-342, June 1982. 65 p, 10 Fig, 7 Tab, 21 Ref, Contract/Grant No. W-7405-eng-26.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Model studies, Biological wastewater treatment, ANFLOW reactor, Computer programs, Methane, Kinetics, Upflow reactor.

A computer program, ANFLOW.F4, was written to model the anaerobic upflow, or ANFLOW bioreactor, developed in the Chemical Technology Division at Oak Ridge National Laboratory. The program predicts sludge accumulation rates, effluent liquid composition, and effluent gas flow rate and composition as a function of time following a change in inlet flow rate or composition. The model can be used to qualitatively study ANFLOW behavior. The ANFLOW reactor was modeled as a settling tank and a series of continuous stirred-tank reactors (CSTR). Residence-time-distribution experiments on the uninoculated column indicate that it is best modeled by two to five CSTRs in series. The number of CSTRs was left as an input parameter in the computer program. A reaction scheme based on conversion of soluble chemical oxygen demand first to volatile acids by acetogenic bacteria and then to methane and carbon dioxide by methanogenic bacteria was selected. Monod and inhibition kinetics were used for acetogenesis and methanogenesis, respectively. Material balances were written for 14 components in each CSTR. Kinetic and equilibrium constants were extracted from the literature, and a numerical integration technique was used to solve the time-dependent steady-state solutions of the material balances. The program was successfully tested for one CSTR. (Author)
W86-00246

EVALUATION OF THE 'LECTRO CLEAR Z' ELECTROCOAGULATION PROCESS FOR MEAT PACKING WASTEWATER TREATMENT.

Western Industrial Labs. Ltd., Edmonton (Alberta).
Report No. EPS 4-WP-82-1, January 1982. Environmental Protection Service, Ottawa, Ontario. 92 p, 4 Fig, 4 Tab, 4 Append.

Descriptors: *Wastewater treatment, *Meat processing industry, *Flotation, Lectro Clear Z unit, Industrial wastewater, Biological wastewater treatment, Coagulation.

The Lectro Clear Z unit is used to pretreat wastes from a meat packing plant in Lethbridge, Alberta. The unit's basic principle is formation of a floc by adjustment of the wastewater pH to 4.0-4.5 with sulfuric acid or sodium hydroxide, addition of chemical, and electrolysis to form hydrogen and oxygen. The gas bubbles float the floc to the surface where it is skimmed. Average BOD in the influent wastewater is 647 mg per liter; average effluent, 284 mg per liter, with a removal of 50%-70%. Suspended solids removals are 68%, from an average of 532 to 173 mg per liter.
W86-00252

ANNOTATED BIBLIOGRAPHY ON NORTHERN ENVIRONMENTAL ENGINEERING, 1978-1979,

Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
For primary bibliographic entry see Field 10C.
W86-00289

5E. Ultimate Disposal Of Wastes

SEAWATER CIRCULATION IN SEWAGE OUTFALL TUNNELS,

New South Wales Univ., Kensington (Australia). Water Research Lab.
D. L. Wilkinson.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 846-857, May, 1985. 6 Fig, 1 Tab, 3 Ref.

Descriptors: *Seawater, *Saline water intrusion, *Wastewater outfall, *Outfall tunnels, Tunnels, Design criteria, Wastewater disposal, Model studies.

As a means of maintaining water quality along the foreshores, sewage wastes at certain sites have been conveyed offshore through tunnels excavated beneath the sea floor and released into the ocean through a series of vertical shafts or risers. The risers are typically 2 to 5 km offshore. The failure of the outfalls at Aberdeen (Scotland) and Weymouth (England) to function as originally planned has been attributed to the intrusion of seawater into the outfall tunnel. Model studies showed that the dense seawater can form a wedge structure in the tunnel which completely blocks the sewage discharge from the more seaward risers; seawater circulates through the more seaward risers to be discharged into the ocean through the riser located immediately above the wedge. A different mode of blocking called circulation blocking occurs when seawater is drawn down the more shoreward risers and a mixture of sewage and seawater discharges from the seaward risers. The magnitude of the circulation was determined in terms of the sewage flow and geometric parameters of the outfall. An expression was derived for the sewage flow required to arrest the circulation. Circulation blocked outfalls will clear when the sewage inflow exceeds a critical flow rate; however, like wedge blocked outfalls, the flow required to achieve is many times greater than the flow needed to prevent intrusion into the diffuser ports. Tunnelled ocean outfalls should be constructed with the design capacity discharge required to purge an outfall subject to circulation blocking. (Collier-IVI)
W86-00017

DIGITAL SIMULATION OF THE REGIONAL EFFECTS OF SUBSURFACE INJECTION OF LIQUID WASTE NEAR PENSACOLA, FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-00122

POTENTIAL FOR CONTAMINATION OF SHALLOW AQUIFERS IN ILLINOIS,

Illinois State Geological Survey Div., Champaign.
R. C. Berg, J. P. Kempton, and K. Cartwright.
Circular 532, 1984. 30 p, 12 Fig, 2 Tab, 2 Plates, 40 Ref.

Descriptors: *Aquifers, *Waste disposal, *Geological mapping, *Groundwater pollution, *Illinois, Mapping, Geohydrology, Geological surveys, Municipal wastes, Solid waste disposal, Underground waste disposal.

The potential for contaminating groundwater resources is a critical concern in Illinois. Contamination may result from land burial of municipal wastes and surface or near-surface disposal of wastes. Aquifers are susceptible to contamination because their hydrogeologic properties allow waste effluents to travel rapidly. Whether a shallow aquifer actually becomes contaminated also depends on the properties of the earth/geologic materials that surround it. The purpose of this project was to describe and map geologic materials to a depth of 50 ft throughout the state of Illinois. The combination of hydrogeologic properties and stratigraphic position of geologic materials provides the basis for mapping the potential for contaminating aquifers. Two maps constructed for this study show the distribution of sequences of geologic materials and their comparative ratings. Each sequence was rated for the susceptibility of its water-yielding materials (aquifers) to contamination from waste-disposal practices. The maps are presented at a scale of 1:500,000 for the entire state. They may be used for suggesting areas where disposal of wastes will have minimum potential for contaminating groundwater resources and for screening areas with low contamination potential as part of the process of locating new disposal sites.
W86-00178

MODIFICATION OF BELL CANYON TEST (BCT) 1-FF GROUT,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
For primary bibliographic entry see Field 8G.
W86-00248

5F. Water Treatment and Quality Alteration

ADVANTAGES OF DISSOLVED-AIR FLOTATION FOR WATER TREATMENT,

Water Research Centre, Stevenage (England).
T. Zabel.
American Water Works Association, Vol. 77, No. 5, p 42-46, May, 1985. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Dissolved-air flotation, *Water treatment, *Physicochemical treatment, Design criteria, Algae, Sedimentation, Flocculation, Coagulation, Turbidity, Softness.

Many raw water sources contain low-density particles such as algae, which, because of their tendency to float, cause problems in the sedimentation stage. In particular, nutrient-rich stored waters that may contain heavy algae blooms are difficult to treat by sedimentation. In addition, treatment of low turbidity, soft, highly colored waters produces very light flocs that settle very slowly. Dissolved-air flotation as a primary clarification stage for the production of potable water is particularly effective for the treatment of these waters. Dissolved-air flotation plants consist of a facility to mix the coagulation chemicals with the raw water and a mechanical flocculation stage, followed by a flotation tank. Part of the treated water is recycled, pressurized, and saturated with air and then introduced to the flocculated water stream via a bank of air injection nozzles. The pressure is reduced to atmospheric pressure across the nozzles thus releasing the air in the form of fine bubbles. The air bubbles attach themselves to the flocs and the bubble-floc agglomerates rise to the surface of the flotation tank and are removed as floated sludge either by flooding or mechanical scraping. Flotation has several process advantages over sedimentation: It can produce better water quality; it can be operated at high surface loadings, resulting in relatively small and shallow plants; and it can be started up quickly, with a steady water quality being achieved within 45 min. Also, the solids concentration of the sludge produced is significantly higher (about 3 percent) than that of sludg produced by sedimentation. Detailed informatio

is given on the design of flocculation and flotation tanks, the air saturation system, the production of microbubbles, and the different sludge removal systems that can be used. Performance data are given for flotation plants used for clarification of several raw waters, with special emphasis on the treament of algae-laden waters and low-turbidity, highly colored waters. (Collier-IVI)
W86-00005

REMOVING BARIUM AND RADIUM THROUGH CALCIUM CATION EXCHANGE,

CH2M Hill, Milwaukee, WI.
A. G. Myers, V. L. Snoeyink, and D. W. Snyder.
Journal of the American Water Works Association, Vol. 77, No. 5, p 60-66, May, 1985. 11 Fig, 5 Tab, 14 Ref. EPA contract CR-808912.

Descriptors: *Barium, *Radium, *Cation exchange, *Water treatment, Drinking water, Groundwater treatment, Ion exchange.

The removal of barium and radium, which are found in many groundwater sources, was achieved in laboratory studies with an ion exchange process. A strong acid resin in the Ca form achieved excellent removal of Ba(2+) and Ra(2+) from water containing 15-30 mg Ba(2+)/L and 43 pCi Ra-226/L. The resin was regenerated easily with CaCl2 brine, and after repeated exhaustion-regeneration cycles using reclaimed brine, the only water quality change observed during the production cycle was the reduction of the Ba(2+) and Ra-226 concentrations. Total hardness, alkalinity, pH, and other parameters were essentially unchanged. Operation of this column in parallel with a strong acid, Na-form column will enable the production of water that meets the standards for Ba and Ra and has the hardness desired for distribution. The capacity of the virgin Ca-form column for Ba(2+) was approximately 75 mg Ba(2+)/g dry resin (H+ form) or 32 g Ba(2+)/l resin (Ca form). The capacity of the column after several exhaustion-regeneration cycles depends on the dosage of regenerant. The CaCl2 regenerant concentration of 0.85M was significantly more effective at a given dosage than higher (1.69M) or lower (0.42M) concentrations. The spent CaCl2 brine can be reclaimed for reuse. The brine reclamation process should significantly reduce the brine disposal problem, but ways of disposing of the precipitates must be found, and the cost involved in using the process must be established. (Baker-IVI)
W86-00008

AWWA SURVEY OF INORGANIC CONTAMINANTS IN WATER SUPPLIES.

Journal of the American Water Works Association, Vol. 77, No. 5, p 67-72, May, 1985. 12 Fig, 5 Tab.

Descriptors: *Drinking water, *Quality control, *United States, *Surveys, *Inorganic compounds, Nitrates, Sulfates, Regulations, Arsenic, Fluoride, Barium, Lead, Selenium, Cadmium, Mercury, Chromium, Silver.

Results of a survey of the United States and its territories on the frequency and extent of inorganic contaminants in drinking water supplies are reported as prepared by AWWA's Inorganic Contaminants Committee, Water Quality Division. Data are presented on the inorganic contaminants listed in the US EPA primary and secondary drinking water regulations. Thirty-nine states responded to the survey with 37 providing data. Problems with meeting the primary inorganic maximum contaminant levels (MCLs) are most common in small communities served by wells (98.4%) rather than in those served by surface water (1.6%). High nitrate concentrations were the primary reason for inactivating wells or systems that were reported to have been shut down. High fluoride was the next most frequently reported reason. Response data were scarce on systems that had been shut down. In terms of frequency only, the main difficulties in meeting the primary MCLs were a result of fluoride, nitrate and to a much lesser extent, selenium, arsenic, barium, and lead contamination. Geographic distribution patterns are clear for the occurrences of excessive nitrate, selenium, barium and arsenic. Ninety percent of the excess fluoride and nitrate-N occurrences were less than 5.0 mg/L and 20.0 mg/L, respectively. The remaining 10% still represent a significant number of water supplies. Twenty-six states responded with actual or estimated data on the secondary inorganic contaminants. If these data are linearly extrapolated for all 50 states, there are about 28,000 occurrences of contaminants in excess of the secondary MCNs. The most common secondary MCL contaminants are iron, manganese, and dissolved solids. Sulfates, chloride, and color are also quite significant. (Baker-IVI)
W86-00009

IN-HOME TREATMENT METHODS FOR REMOVING VOLATILE ORGANIC CHEMICALS,

Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
R. K. Sorrell, E. M. Daly, M. J. Weisner, and H. J. Brass.
Journal of the American Water Works Association, Vol. 77, No. 5, p 72-78, May, 1985. 6 Fig, 13 Tab, 13 Ref.

Descriptors: *Volatile compounds, *Organic compounds, *Drinking water, *Water treatment, Boiling, Electric mixing, Aeration.

The effectiveness of six in-home treatment methods for removing volatile organic chemicals (VOCs) from drinking water was investigated. At least two methods appeared excellent for temporary use in emergency situations. Boiling and electric mixing afforded about 100% removal of the test compounds (chloroform, 1,1,1-trichloroethane, carbon tetrachloride, trichloroethylene, bromoform, tetrachloroethylene, t-butyl methyl ether, benzene, ethylbenzene, m-xylene, and m-dichlorobenzene) using ordinary kitchen appliances, in phase 1. Phase 1 of the testing involved six methods - boiling, electric mixing, open standing, aeration, pouring and faucet aeration. The first four methods were reexamined in phase 2, during which VOC loss over time was monitored. Loss of VOCs by boiling was found to be variable. This variability was likely due to the lower heating efficiency of the household stove which made it difficult to determine the start of boiling. The estimated cost per month of treating water by boiling for a family of four would be about $4.70. Electric mixing provided excellent removal of VOCs in phases 1 and 2. The estimated cost to a household was about $0.30 per month using this method. A third method, open standing, provided reasonable removal without any significant compound bias. However, the length of treatment required, 48-72 hr, is excessive. Aeration was less effective and very compound dependent. While the risk of inhaling volatile organic chemicals evolved from water is basically unknown, it may be of a similar magnitude to that of ingesting water containing such chemicals, if very large volumes are being treated. This risk is also involved in such activities as cooking, showering, bathing, and using humidifiers and vaporizers. (Baker-IVI)
W86-00010

REMOVAL BY COAGULATION OF TRACE ORGANICS FROM MISSISSIPPI RIVER WATER,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
M. J. Semmens, and K. Ayers.
Journal of the American Water Works Association, Vol. 77, No. 5, p 79-84, May, 1985. 15 Fig, 4 Tab, 26 Ref. EPA grant CR806377.

Descriptors: *Mississippi River, *Organic compounds, *Water treatment, *Coagulation, Salicylic acid, Acidity, Trace compounds, Octanoic acid, Phenols, Benzoic acid, Organic matter.

Studies were conducted on the removal of four truly soluble, low-molecular weight model compounds (octanoic acid, phenol, benzoic acid, and salicylic acid) by coagulation with alum and iron salts. The model compounds were generally poorly removed by coagulation. The extent of removal was weakly dependent on coagulant dosage except for salicylic acid, which showed improved removal at higher dosages in the presence of natural organics. Removal of the model organic compounds was generally better in the absence of natural organic matter. Percentage removals of the model organic compounds were similar to the removals of the <1K molecular weight fraction of the natural organic matter. The pH influenced the removal of compounds containing a phenolic-OH functional group but did not influence those containing only carboxylic acid functional groups. Coagulation removed intermediate and high molecular weight organic compounds (1-10K and 10-100K) most effectively. Removal of the model organic compounds by coagulants appeared to result from complex formation and precipitation, with the soluble metal-organic complexes formed at the low concentration (about 8 x 10 to the minus 7th power) tested limiting the extent of removal. Simple adsorption does not appear to be a significant mechanism of removal under the conditions tested. (Baker-IVI)
W86-00011

EFFECTS ON GROUNDWATER QUALITY OF THE INTRODUCTION OF SECONDARY SEWAGE TREATMENT TO AN EFFLUENT RECHARGE SITE ON THE CHALK OF SOUTHERN ENGLAND,

Water Research Centre, Marlow (England).
For primary bibliographic entry see Field 5D.
W86-00043

FATE OF ALDICARB, ALDICARB SULFOXIDE, AND ALDICARB SULFONE IN FLORIDAN GROUNDWATER,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 5B.
W86-00045

RAINWATER CATCHMENT WATER QUALITY IN MICRONESIA,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3B.
W86-00061

COMPARATIVE EFFECTIVENESS OF ANTIFOULING TREATMENT REGIMES USING CHLORINE OR A SLOW-RELEASING BROMINE BIOCIDE,

Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
R. J. Soracco, E. W. Wilde, L. A. Mayack, and D. H. Pope.
Water Research, Vol. 19, No. 6, p 763-766, 1985. 2 Fig, 9 Ref.

Descriptors: *Fouling, *Antifouling, *Chlorine, *Biocides, *Bromine biocides, Heat exchangers, Water treatment, Cooling water, Pesticides, Industrial water.

Five chlorine (Cl2) and three slow-releasing bromine biocide (1-bromo-3-chloro-5,5-dimethylhydantoin (BCDMH)) treatment regimes were compared under laboratory conditions to determine their effectiveness in controlling the fouling of 304L stainless steel heat exchanger tubing. The most effective Cl2 treatments were low level (0.1 ppm or less) continuous applications. Three intermittent Cl2 treatments (1 h/day at 1.0 ppm, 1 h/day at 0.5 ppm, and 3 x 20 min/day at 0.5 ppm) were about equally effective. However, all three intermittent regimes were significantly less effective than the low level continuous treatments. The effectiveness of BCDMH treatment was similar to Cl2 when used intermittently at similar residual concentrations at Cl2 for 1 h/day and continuously at low levels. These experiments indicated that low level continuous treatment was more effective than intermittent treatment for controlling biofouling. (Author's abstract)
W86-00063

INACTIVATION OF NAEGLERIA GRUBERI CYSTS BY CHLORINE DIOXIDE,

Ohio State Univ., Columbus. Dept. of Civil Engineering.
Y. S. R. Chen, O. J. Sproul, and A. J. Rubin.
Water Research, Vol. 19, No. 6, p 783-789, 1985. 6 Fig, 4 Tab, 27 Ref. U.S. EPA Office of Exploratory Research grant R808150-02-0.

Descriptors: *Naegleria, *Protozoans, *Chlorine dioxide, *Water treatment, *Cysts, Hydrogen ion concentration, Water temperature, Disinfection, Ozonation, Poliovirus, Viruses.

The kinetics of chlorine dioxide inactivation of Naegleria gruberi cysts (a nonpathogenic soil and water protozoan closely related to the human parasite N. fowleri) were investigated as were the influence of pH from 5 to 9, temperature from 5 to 30 C, cyst age from 3 to 12 days, and cyst clumping. Survivals were obtained for each study as a function of time at several chlorine dioxide concentrations. Inactivation was characterized by an initial concave downward shoulder followed by an essentially linear portion but the process obeyed Watson's Law. At 25 C and pH 7 the mean concentration time product for 99% inactivation was 5.5 mg x min/l. These products varied inversely with temperature and pH. The mean concentration time product for 99% inactivation roughly doubles for each 10 C rise in the water temperature. The actual ratios were 1.6 between 5 and 15 C and 1.7 between 15 and 25 C. Ozone has the lowest time-concentration products followed in order by chlorine dioxide and chlorine. Ozone is distinctly the better disinfectant under lower temperature and at pH's of 8 or less. At a pH of 9 and at 25 C chlorine dioxide approaches ozone in effectiveness. Chlorine, at pH's above 7, rapidly loses its effectiveness as the hypochlorous acid ionizes to the hypochlorite ion. The N. gruberi cyst is distinctly more difficult to inactivate than poliovirus 1 but on the same order as bacterial spores. (Collier-IVI)
W86-00066

OPTIMAL URBAN WATER DISTRIBUTION DESIGN,

MacLaren Engineers, Winnipeg (Manitoba).
D. R. Morgan, and I. C. Goulter.
Water Resources Research, Vol. 21, No. 5, p 642-652, May, 1985. 7 Fig, 9 Tab, 19 Ref.

Descriptors: *Linear programming, *Water conveyance, *Hardy-Cross network solver technique, Cost analysis, Economic factors, Model studies, Optimization.

An iterative procedure capable of analyzing both layout and design of new systems and expansion of existing systems has been developed. One of the major advantages of the technique is that it ensures hydraulic consistency in each of the networks considered during the iterative procedure. In the design of new systems a wide range of loading patterns and pipe failure combinations can be considered. The manner in which the large number of constraints associated with all possible load combinations is reduced to a manageable size does not permit a claim for global optimality. The procedure must therefore be classified as heuristic. The results obtained by the procedure show that it is capable of efficiently producing economical solutions. The method has been demonstrated as being applicable to the layout and design of a network of 2 sources, 20 nodes, and 37 links, and the expansion of an existing network. Comparison of the results produced by this procedure for a network expansion problem with the results of previous studies for the same problem shows that this procedure produces an inexpensive solution in an efficient manner. The procedure is relatively simple, being based on two widely available and accepted techniques, the Hardy-Cross Network solver and linear programming operations research technique. The ability of the model to use the very efficient simplex algorithm of the linear programming makes the procedure applicable to large systems. The method also utilizes realistic and easily accessible pipe cost functions using standard cost data, i.e., cost per unit length. (Baker-IVI)
W86-00071

CHEMISTRY FOR OPERATORS,

Muskegon County Board, MI. Dept. of Public Works.
R. L. Fountain.
Water Treatment Plant Operation Series, Volume 4, Ann Arbor Science, Ann Arbor, MI. 1982. Edited by V. W. Langworthy. 148 p.

Descriptors: *Chemical reactions, *Reviews, *Wastewater treatment, Chlorination, Alkalinity, Coagulation, Flocculation, Phosphorus removal, Water softening, Nitrogen.

This book was written to provide the operators of water and wastewater treatment plants with a basic course in chemical theory and the chemical reactions that occur at such facilities. The first eight chapters cover basic theory and principles essential to all chemical reactions. The remaining chapters deal with chlorination, alkalinity, coagulation and flocculation, water softening, and phosphorus and nitrogen removal. Each chapter concludes with a set of problems and their solutions. The chapter on chlorination explains oxidation-reduction reactions, reactions with impurities, breakpoint chlorination, and the determination of chloride residuals. The chapter on alkalinity discusses the determination of alkalinity. The causes of turbidity and color are discussed in the chapter on coagulation and flocculation, along with the control of coagulation, the jar test, and zeta potential. The lime-soda process and the ion exchange process are considered in the chapter on water softening. In the chapter on phosphorus and nitrogen removal, nitrogen removal by biological nitrification-dentrification, breakpoint chlorination, selective ion exchange, and air stripping of ammonia is considered.
W86-00134

HYDRAULICS FOR OPERATORS,

Michigan Dept. of Public Health, Lansing. Section of Water Supply.
For primary bibliographic entry see Field 8B.
W86-00135

ENVIRONMENTAL ENGINEERING,

Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind, and J. J. Peirce.
Butterworth, Boston. 1982. 602 p.

Descriptors: *Water treatment, *Wastewater treatment, *Water analysis, *Water pollution sources, *Water pollution effects, *Public health, *Sludge treatment, *Sludge disposal, Nonpoint source pollution, *Water law, Radioactive wastes, *Water supply, *Water distribution, *Sewers, Biodegradation, Wastewater characteristics, Environmental effects, Landfills.

A textbook on environmental engineering is organized in five major areas: water resources, air quality, solid and hazardous wastes, noise, and environmental impact. Water-related topics include water pollution, measurement of water quality, water supply and transmission, water treatment methods, wastewater collection and treatment, sludge treatment and disposal, nonpoint source water pollution and its control, water pollution law, landfills, and environmental impact and assessment.
W86-00188

5G. Water Quality Control

SEAWATER CIRCULATION IN SEWAGE OUTFALL TUNNELS,

New South Wales Univ., Kensington (Australia). Water Research Lab.
For primary bibliographic entry see Field 5E.
W86-00017

HYPOLIMNETIC AERATION: PRACTICAL DESIGN AND APPLICATION,

British Columbia Ministry of Environment, Vancouver. Fisheries Research and Technical Services Section.
K. I. Ashley.
Water Research, Vol. 19, No. 6, p 735-740, 1985. 23 Ref, 1 Append. NRC grant 67-3454.

Descriptors: *Aeration, *Hypolimnetic aeration, *Lake restoration, *Fisheries managment, Destratification, Design criteria, Oxygenation.

Hypolimnetic aeration is becoming increasingly important as a fisheries management and water quality improvement technique, however its application has been restricted by a paucity of practical reference material. Hypolimnetic aeration includes partial and full lift designs and several air/oxygen injection systems. Positive displacement compressors flanged to three phase electric motors are the preferred air supply and power for most lake aeration projects. Internal combustion power is adequate for short term use and wind power is in the developmental stage. Rubber compressed air hose is recommended for lake aeration applications. Free air delivery is the air volume taken into the compressor at standard temperature and pressure however actual output volume is regulated by discharge pressure. Performance specifications of full lift hypolimnetic aerators are based on water:air ratios, oxygen increase, transfer efficiencies and oxygenation capacity. An empirical sizing method was developed using hypolimnetic volume, hypolimnetic oxygen consumption, water flow, air flow and inflow tube radius. Outflow tube radius should equal or exceed inflow tube radius to achieve high flow rates and allow efficient removal of residual bubbles. Floatation requirements were calculated from the total weight of the separator box, inflow and outflow tubes and the theoretical water head. (Author's abstract)
W86-00060

RELEASE OF ENDOTHALL FROM AQUATHOL GRANULAR AQUATIC HERBICIDE,

North Texas State Univ., Denton. Dept. of Biological Sciences.
K. H. Reinert, S. Stewart, M. L. Hinman, J. H. Rogers, Jr., and T. H. Leslie.
Water Research, Vol. 19, No. 6, p 805-808, 1985. 3 Fig, 3 Tab, 21 Ref.

Descriptors: *Herbicides, *Fate of pollutants, *Endothall, *Aquatic plants, *Pesticide kinetics, Kinetics, Fish, Sunfish, Water pollution effects.

The release rate kinetics of endothall from Aquathol Granular Aquatic Herbicide (Aquathol) were determined in two static shake flask tests and the release half-life was determined from the release rate. A zero-order release rate of 1.58 mg/l/h and a half-life of 5.06 h were calculated from the replicate studies. These experiments show that Aquathol releases endothall relatively rapidly in a static environment; however, this release would be expected to be faster in a dynamic aquatic system such as a reservoir where horizontal dispersion and dilution can occur. The release rate, when coupled with the fate processes affecting endothall persistence in aqueous systems and the relatively high endothall concentration required for acute toxicity to non-target organisms such as bluegill sunfish (428 mg/l), make Aquathol a candidate for control of nuisance aquatic vegetation where water usages are critical. (Collier-IVI)
W86-00068

APPLICATION OF THE STORM MODEL TO DESIGN PROBLEMS IN SINGAPORE AND IN KAOSIUNG, REPUBLIC OF CHINA,

Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 6A.
W86-00086

MIXING ZONE MODEL FOR CONSERVATIVE PARAMETERS,

Oklahoma Water Resources Board, Oklahoma City.
M. R. Hutcheson.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 65-86, 11 Fig, 1 Tab, 12 Ref.

Descriptors: *Model studies, *Waste load, *Mixing, Water quality, *Water quality management, *Mathematical studies, *Water quality standards, *Numerical analysis, Models, Nonpoint pollution sources, Wastewater disposal, Water quality control, Industrial wastes.

The development of a wasteload allocation process which incorporates a numerical solution to the dispersion equation is described. The methodology relies on simplification of the dispersion equation through the use of assumptions so that it may be solved numerically. Then a relationship between the standard deviation of a Gaussian distribution and the dispersion coefficient is derived. A relationship for the standard deviation, hence the dispersion coefficient is developed based on hydrology and plume dimensions. The dispersion equation is solved numerically for pollutant concentration at grid points throughout the mixing zone. The maximum concentration at the end of the mixing zone, the related source strength, the background concentration and the water quality standard are used to determine the wasteload allocation which will protect the water quality standard. This process is applicable to multiple discharges as well as isolated ones, using the superposition principle. The methodology was applied to an industrial point source (Farmland Industries) that discharges into Skeleton Creek. It was demonstrated that the dispersion model can predict concentration distributions well enough to develop permit limits which will allow water quality standards in a receiving stream to be met.
W86-00089

SOME RECENT ADAPTATIONS AND APPLICATIONS OF QUAL-II IN THE NORTHEAST,

For primary bibliographic entry see Field 5B.
W86-00090

REVIEW OF MODEL USE IN EVALUATING NONPOINT SOURCE LOADS FROM FOREST MANAGEMENT ACTIVITIES,

National Council of the Paper Industry for Air and Stream Improvement Inc., New York.
For primary bibliographic entry see Field 5B.
W86-00091

MECHANISTIC SIMULATION FOR TRANSPORT OF NONPOINT SOURCE POLLUTANTS,

Simons, Li and Associates, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 5B.
W86-00092

PLANNING AND IMPLEMENTATION OF REGIONAL STORMWATER MANAGEMENT FACILITIES IN MONTGOMERY COUNTY, MARYLAND,

Greenhorne and O'Mara, Inc., Riverdale, MD.
For primary bibliographic entry see Field 4A.
W86-00099

NUTRIENT INPUT FROM THE LOXAHATCHEE RIVER ENVIRONMENTAL CONTROL DISTRICT SEWAGE-TREATMENT PLANT TO THE LOXAHATCHEE RIVER ESTUARY, SOUTHEASTERN FLORIDA,

Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-00110

NATIONAL WATER SUMMARY 1983--HYDROLOGIC EVENTS AND ISSUES.

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W86-00131

ECONOMIC PERSPECTIVES ON ACID DEPOSITION CONTROL.

Acid Precipitation Series, Volume 8, Butterworth Publishers, Boston, 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. 180 p.

Descriptors: *Water quality control, *Acid rain, *Air pollution, Precipitation, *Economic aspects, Policy making, Fate of pollutants, Fisheries, Decision making, Cost analysis, Model studies, Legal aspects, Canada.

Papers on the economic aspects of acid aspects of acid deposition control are grouped into five general topics: (1) policy perspectives (the current level of scientific knowledge relative to possible control decisions), (2) economic benefits of control (dose-response estimation, economic damages to the Adirondack fisheries, and economic damages from a Canadian perspective), (3) international aspects (legal, economic, and political aspects of transfrontier pollution), (4) economically optimal control strategies, and (5) economic caveats.
W86-00136

ACID RAIN: DOES SCIENCE DICTATE POLICY OR POLICY DICTATE SCIENCE,

Georgia Univ., Athens. Inst. of Natural Resources.
For primary bibliographic entry see Field 6E.
W86-00137

EFFECT OF GLOBAL OPTIMIZATION ON LOCALLY OPTIMAL POLLUTION CONTROL: ACID RAIN,

West Virginia Univ., Morgantown. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W86-00138

ECONOMICALLY RELEVANT RESPONSE ESTIMATION AND THE VALUE OF INFORMATION: ACID DEPOSITION,

Oregon State Univ., Corvallis. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W86-00139

SCIENTIFIC TRUTHS AND POLICY TRUTHS IN ACID DEPOSITION RESEARCH,

Wyoming Univ., Laramie. Dept. of Economics.
For primary bibliographic entry see Field 6B.
W86-00140

NORMATIVE ECONOMICS AND THE ACID RAIN PROBLEM,

Oklahoma Univ., Norman. Div. of Economics.
For primary bibliographic entry see Field 6B.
W86-00141

ECONOMIC IMPACT OF ACID PRECIPITATION: A CANADIAN PERSPECTIVE,

Oklahoma Univ., Norman. Div. of Economics.
For primary bibliographic entry see Field 6C.
W86-00142

LEGAL, ETHICAL, ECONOMIC AND POLITICAL ASPECTS OF TRANSFRONTIER POLLUTION,

Resources for the Future, Inc., Washington, DC.
For primary bibliographic entry see Field 6E.
W86-00143

ACIDIFICATION IMPACT ON FISHERIES: SUBSTITUTION AND THE VALUATION OF RECREATION RESOURCES,

Clarkson Univ., Potsdam, NY. Dept. of Economics.
F. C. Menz, and J. K. Mullen.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 135-155, 3 Fig, 6 Tab, 44 Ref.

Descriptors: *Water pollution effects, *Cost analysis, *Acid rain, *Fisheries, Precipitation, Air pollution, Economic aspects, Adirondack Mountains, New York, Lake fisheries, Stream fisheries, Recreation, Model studies.

Economic losses to anglers in the Adirondack recreational fishery resulting from acidification damage were estimated at $1.7-3.2 million, depending on assumptions pertaining to habitat loss and substitution by anglers among fisheries. These were considered lower-bound estimates for the following reasons: (1) estimates were based only on licensed New York resident anglers fishing in waters open to public fishing, (2) they were based on the assumption that information concerning the effect of acidification on alternative fishing sites is known and accurately perceived by the angling population, (3) estimates of currently perceived damages may understate future damages if acidification is irreversible, and (4) results of this study pertained only to the currently observable effects of acidification on a limited portion of the Adirondack recreational fishery.
W86-00144

TRANSFERABLE DISCHARGE PERMITS AND PROFIT-MAXIMIZING BEHAVIOR,

Wyoming Univ., Laramie. Dept. of Economics.
J. T. Tschirhart.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 157-171, 3 Fig, 14 Ref, 1 Append.

Descriptors: *Water quality control, *Acid rain, *Air pollution, Water pollution control, Permits, Economic aspects, Transferable discharge permits, Precipitation, Profit, Regulations.

A model of a profit-maximizing firm was presented where the firm confronts an emission standard and has the options to either install scrubbers or enter into transferable discharge permit (TDP) markets. The results of the model characterize how the firm chooses among the options to meet the standard at minimum cost. However, the driving force behind the minimum cost solution is that the firm is a profit maximizer. There are situations where this may not be an appropriate assumption. For instance, in regulated industries where constraints on profits are invoked by government commissions, the minimum cost solution is not attained. A bias toward overutilization of scrubbers is possible. Even in nonregulated industries, however, there are plausible reasons why firms do not maximize profit, including uncertainty, organization complexity and alternative goals. All of this is not to say that TDP markets should be abandoned. Instead, this chapter contains a number of pitfalls that regulators should be aware of when implementing TDP markets. How important these pitfalls are is an empirical question that cannot be answered until the market are allowed to operate for some time. Until then, control agencies should closely observe those firms that may be candidates for these pitfalls, particularly those in regulated industries. And if their behavior deviated from that outlined above, adjustments in the TDP system are in order. (Author)
W86-00145

TECHNIQUES TO REDUCE THE SEDIMENT RESUSPENSION CAUSED BY DREDGING,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
G. L. Raymond.
Miscellaneous Paper HL-84-3, September 1984. Final Report. 33 p, 14 Fig, 15 Ref.

Descriptors: *Suspended solids, *Dredging, *Suspended sediments, *Ecological effects, Bottom sediments, Dredges, Turbidity, Reviews, Fluvial sediments, Marine sediments, Design criteria, Polychlorinated biphenyls, Water resources development, Channel improvement.

As part of a larger effort under the Improvement of Operation and Maintenance Techniques Program to develop a method to predict the extent of sediment resuspension and contaminant release when dredging in contaminated sediments, the U. S. Army Engineer Waterways Experiment Station's Water Resources Engineering Group is conducting field studies to evaluate new and existing

dredging methods. The level of sediment resuspended by a given dredge type in a given sediment was examined using various operational parameters. Results of the first 2 yr of study which included field work and extensive literature reviews show that different dredge types produce different amounts of suspended sediment in different parts of the water column. Resuspensions caused by cutterhead and hopper dredges tend to remain in the lower water column, while bucket dredges increase resuspensions throughout the water columns. The amount of resuspension caused by a given dredge type also depends on the operating techniques used with the dredge. Sediment resuspension can be lessened by changing operating techniques, as in the case of the cutterhead, or by modifying the equipment, such as enclosing a clamshell bucket. Special purpose dredges can also be used to reduce sediment resuspension, but their lower production rates limit their application.
W86-00159

POTENTIAL FOR CONTAMINATION OF SHALLOW AQUIFERS IN ILLINOIS,

Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W86-00178

SORPTION BEHAVIOUR OF 14C IN GROUNDWATER/ROCK AND IN GROUNDWATER/CONCRETE ENVIRONMENTS,

Seakem Oceanography Ltd., Sidney (British Columbia).
For primary bibliographic entry see Field 5B.
W86-00184

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, 1978-JULY, 1981: CITATIONS FROM THE NTIS DATA BASE.

National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 4C.
W86-00201

DEVELOPMENT DOCUMENT FOR EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE TEXTILE MILLS POINT SOURCE CATEGORY.

Environmental Protection Agency, Washington, DC. Effluent Guidelines Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116871. EPA 440/1-82/022, September 1982. Final Report. 509 p, 11 Fig, 152 Tab, 238 Ref, 1 Append.

Descriptors: *Water quality control, *Wastewater treatment, *Textile mill wastes, *Industrial wastes, *Standards, *Effluent limitations, *Water pollution sources, *Wastewater composition, Water pollution control, Water use, Water reuse, Water conservation, Conservation, Chemical wastes, Wool, Biological wastewater treatment, Process control.

Textile manufacturing facilities were studied to develop effluent limitations for existing point sources, standards of performance for new sources, and pretreatment standards for existing and new sources. The industry was divided into several subcategories: wool scouring, wool finishing, low water use processing, woven fabric finishing, knit fabric finishing, carpet finishing, stock and yarn finishing, nonwoven manufacturing, and felted fabric processing. Raw wastewater characteristics vary widely among the categories and also within each category, depending on raw materials and process control. Of 123 toxic pollutants, only 22 were not present or suspected to be present in textile mill wastewaters. Data are listed for analyses of toxic pollutants in the water supply and in treated effluents. The following wastewater constituents were designated as subject to limitation under BPT, BAT and NSPS as appropriate: BOD, total suspended solids, pH, total chromium, COD, phenols, and sulfide. In-plant controls and process changes suitable for pollution control include water reuse, water use reduction, chemical substitution, and material reclamation. Available wastewater treatment technologies are described in detail.
W86-00207

OIL SHALE MINING, PROCESSING, USES, AND ENVIRONMENTAL IMPACTS, AUGUST, 1981-OCTOBER, 1982: CITATIONS FROM THE NTIS DATA BASE.

National Technical Information Service, Springfield, VA.
For primary bibliographic entry see Field 5D.
W86-00215

RESTORATION OF HABITATS IMPACTED BY OIL SPILLS.

For primary bibliographic entry see Field 5C.
W86-00239

RECOVERY AND RESTORATION OF ROCKY SHORES, SANDY BEACHES, TIDAL FLATS, AND SHALLOW SUBTIDAL BOTTOMS IMPACTED BY OIL SPILLS,

Stockholm Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W86-00240

EFFECTS OF OIL ON SEAGRASS ECOSYSTEMS,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W86-00241

RECOVERY AND RESTORATION OF SALT MARSHES AND MANGROVES FOLLOWING AN OIL SPILL,

Research Planning Inst., Inc., Columbia, SC.
For primary bibliographic entry see Field 5C.
W86-00242

MEASUREMENTS OF DAMAGE, RECOVERY, AND REHABILITATION OF CORAL REEFS EXPOSED TO OIL,

Continental Shelf Associates, Inc., Boulder, CO.
For primary bibliographic entry see Field 5C.
W86-00243

FISHERIES RESOURCE IMPACTS FROM SPILLS OF OIL OR HAZARDOUS SUBSTANCES,

Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5C.
W86-00244

LEACHATE FROM HAZARDOUS WASTES SITES,

New Jersey Inst. of Tech., Newark. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W86-00247

PLANNING GUIDE FOR EVALUATING AGRICULTURAL NONPOINT SOURCE WATER QUALITY CONTROLS,

Cornell Univ., Ithaca, NY.
P. D. Robillard, M. F. Walter, and L. M. Bruckner.
EPA-600/3-82-021, September 1982. Environmental Research Laboratory, Athens, GA. 733 p, 33 Fig, 22 Tab, 23 Refs, 6 Append. Contract/Grant No. R804925010.

Descriptors: *Water quality control, *Water pollution sources, *Fate of pollutants, *Agriculture, *Nonpoint pollution sources, Planning, Pollution load, Nitrogen, Phosphorus, Sediment, Animal wastes, Salinity, Nutrients, Farm management, Farm wastes, Insecticides, Pesticides, Fertilizers, Irrigation, Eutrophication, Soil conservation, Sediment transport, Erosion control, Cover crops, Terracing, Economic aspects, Honey Creek, Ohio, Yakima River, Washington, Cornell Nutrient Simulation Model, Model studies.

This is a manual for evaluation and selection of agricultural nonpoint source controls for irrigated and nonirrigated cropland. The methodology applies to areas ranging in size from an individual farm to a large region. Agricultural practices and their impacts on water quality are described. Pollutants of concern are nitrogen, phosphorus, sediment, animal wastes, and salinity. Pollution control measures involving tillage methods, cropping practices, and methods of fertilizer and pesticide application are divided into three groups: structural, vegetative, and managerial. The evaluation methodology consists of several steps: (1) description of the watershed, (2) identification of the problem, (3) determination of applicable control measures, (4) choice of the unit of analysis, (5) establishment of the base condition, (6) evaluation of control measures, and (7) development of an optimal control strategy. The methodology is demonstrated with two examples: an individual farm in the Yakima River basin, Washington, and the Honey Creek, Ohio, watershed. The six appendixes, comprising 600 pages of the manual, concern sediment and nutrient loadings from nonirrigated croplands, sediment and nutrient loss from irrigated agriculture, salinity control, water quality problems related to animal agriculture, insecticide use, and economic perspectives of nonpoint source water quality management.
W86-00260

WINTER EVALUATION OF OIL SKIMMERS AND BOOMS.

Environmental Protection Service, Ottawa (Ontario).
Report EPS 4-EP-84-1, February 1984. 109 p, 39 Fig, 17 Tab, 7 Ref, 3 Append.

Descriptors: *Water quality control, *Water pollution control, *Oil recovery, *Cleanup, Oil skimmers, Booms, Oil spills, Little Giant, Destroil, Slicklicker, Skim-Pak, Morris MI-80, Arctic Skimmer, Arctic Marine Oilspill Program, Zoom Boom, Albany Oilfence, Troilboom, Vikoma Seapack, Cold regions.

Five mechanical oil recovery devices (skimmers) and six oil containment barriers were evaluated in Newfoundland and Nova Scotia during March-April 1980. The skimmers varied in size, collection principle, and intended application. Specific comments were given for each. However, some general conclusions were drawn. Only the Destroil and Versatech Arctic Skimmer were deemed capable of surviving moderate sea conditions. Although they can recover a wide range of oils, they would have difficult processing cold Bunker C directly from the water's surface. The Skim-Pak was considered useful for crude oil or low viscosity products in calm water. The Slicklicker, as a shore-mounted unit, was judged useful for handling Bunker C and solids. Little Giant showed promise as a Bunker C recovery device. The Morris MI-80, as presently designed, proved to be too complicated. The U.S. Coast Guard boom proved durable, well designed, and of high quality construction. The AMOP and Zoom booms effectively contained oil; the length of the lower tension member was an important factor. All booms tested were strong enough and durable enough to handle realistic loads.
W86-00290

EUROPEAN AND UNITED STATES CASE STUDIES IN APPLICATION OF THE CREAMS MODEL.

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
For primary bibliographic entry see Field 5B.
W86-00294

CREAMS: A SYSTEM FOR EVALUATING MANAGEMENT PRACTICES ON FIELD-SIZE AREAS,

Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W86-00295

TESTING THE APPLICATION OF CREAMS TO FINNISH CONDITIONS,
National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5B.
W86-00296

ENVIRONMENTAL EFFECTS OF NITROGEN FERTILIZATION EXEMPLIFIED BY GROUNDWATER POLLUTION AS SIMULATED BY CREAMS,
Goettingen Univ. (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W86-00297

APPLICATION OF THE CREAMS MODEL FOR CALCULATION OF LEACHING OF NITRATE FROM LIGHT SOILS IN THE NOTEC RIVER VALLEY,
Institute for Land Reclamation and Grassland Farming, Raszyn (Poland).
For primary bibliographic entry see Field 5B.
W86-00298

APPLICATION OF THE CREAMS MODEL: WESTERN SKANE, SWEDEN,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 5B.
W86-00299

PREDICTING HILLSLOPE RUNOFF AND EROSION IN THE UNITED KINGDOM: PRELIMINARY TRIALS WITH THE CREAMS MODEL,
National Coll. of Agricultural Engineering, Silsoe (England).
For primary bibliographic entry see Field 5B.
W86-00300

APPLICATION OF THE CREAMS MODEL AS PART OF AN OVERALL SYSTEM FOR OPTIMIZING ENVIRONMENTAL MANAGEMENT IN LITHUANIA, USSR: FIRST EXPERIMENTS,
Lithuanian Research Inst. of Forestry, Vilnius (USSR).
For primary bibliographic entry see Field 5B.
W86-00301

REVIEW OF CASE STUDIES OF CREAMS MODEL APPLICATION,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W86-00302

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

DYNAMIC MODEL FOR MULTIRESERVOIR OPERATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. A. Marino, and H. A. Loaiciga.
Water Resources Research, Vol. 21, No. 5, p 619-630, May, 1985. 8 Fig, 5 Tab, 29 Ref. University of California, Water Resources Center project UCAL-WRC-W-634.

Descriptors: *Model studies, *Reservoir operation, *Operating policies, *Central Valley Project, *California, Planning, Management planning, Hydroelectric power, Electric power production.

A methodology to obtain optimal reservoir operation policies for a large-scale reservoir system was developed. The model yields medium-term (one-year-ahead) optimal release policies that allow the planning of activities within the current water year, with the possibility of updating preplanned activities to account for uncertain events that affect the state of the system. River flows are characterized as a multivariate autoregressive process and are forecasted using maximum likelihood estimators. The solution method is a sequential dynamic decomposition algorithm that keeps computational requirements and dimensionality problems at low levels. The model maximizes the system annual energy generation while satisfying constraints imposed on the operation of the reservoir network. Several alternative versions of the model can be used under different assumptions. The model was applied to a large-scale multireservoir system, the northern portion of the California Central Valley Project. The optimal release policies show a potential increase in the system total annual energy with respect to heuristic schedules currently in use. (Author's abstract)
W86-00069

QUADRATIC MODEL FOR RESERVOIR MANAGEMENT: APPLICATION TO THE CENTRAL VALLEY PROJECT,
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. A. Marino, and H. A. Loaiciga.
Water Resources Research, Vol. 21, No. 5, p 631-641, May, 1985. 4 Fig, 3 Tab, 6 Ref.

Descriptors: *Reservoir operation, *Central Valley Project, *California, *Model studies, *Quadratic models, Optimization, Planning, Water management, Reservoir releases, Hydroelectric power.

A quadratic optimization model is applied to the Central Valley Project in California to obtain operation schedules. The model has the minimum possible dimensionality, treates spillage and penstock releases as decision variables and takes advantage of system-dependent features to reduce the size of the decision space. The quadratic optimization model was compared with a linear model. Both models lead to a potential increase in the annual energy production, as was demonstrated for a water year of average streamflow conditions. The quadratic model showed that the Sacramento-San Joaquin Valley agricultural water deliveries can be increased by adopting the optimal release policies. This suggests the possibility of expanding irrigated areas, providing better leaching of agricultural fields, and improving conjunctive management of agricultural fields, and improving conjunctive management of surface and groundwater reservoirs. Although the release policies computed by the quadratic and linear models were similar, there are reasons for preferring the quadratic model. First, it leads to problems of lower dimensionality and provides a closer representation of the physical features of the system, particularly with regard to nonlinearities in the objective function and constraints. Second, because of its capability to incorporate spillages explicitly, the quadratic model can handle a reservoir system of more complicated configuration and complex mass balance equation. (Baker-IVI)
W86-00070

APPLICATION OF THE STORM MODEL TO DESIGN PROBLEMS IN SINGAPORE AND IN KAOSIUNG, REPUBLIC OF CHINA,
Camp, Dresser and McKee, Inc., Boston, MA.
B. M. Harley.
In: Proceedings of Stormwater and Water Quality Model Users Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 22-42, 11 Fig.

Descriptors: *Model studies, *Project planning, *Design criteria, *Urban runoff, *Developing countries, *Water supply development, *Sewer systems, Storm runoff, Hydrologic models, Simulation analysis, Wastewater treatment.

Two examples of the application of modified versions of the STORM model are presented. The first application involved a study in Singapore where urban stormwater runoff was to be captured and treated to augment the island's water supply. The STORM model was used to evaluate the basin runoff, to size the diversion/storage/pumping facilities, and to help determine the effective safe yield from the proposed project. The STORM model also enabled the design team to evaluate the effectiveness of the many quantity and quality control options which should be considered during project development. The second application of the STORM model was in the development of design strategies to control heavily contaminated combined sewer overflows to the Jen Ai River of Kaohsiung, Republic of China. The design study was for a series of major combined sewer overflow structures which, in conjunction with a single trunk sewer, will reduce BOD loadings on the river by over 90%. Use was made of the model's ability to simulate the effect of storage and local treatment at each of the control facilities. These two examples demonstrate that models such as STORM can be effectively used in design situations in developing countries.
W86-00086

ATTEMPT TO IMPLEMENT SWMM IN TUNISIA,
Lund Univ. (Sweden).
J. Niemczynowicz.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 43-52, 7 Fig, 5 Ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Hydrologic models, *Urban runoff, *Storm runoff, *Storm water, *Computer models, *Hydrographs, Runoff, Storm sewers, Management planning, Urban hydrology.

To aid the city of Tunis in stormwater management, a cooperative project was undertaken by the Universities of Lund and Tunis to apply the Storm Water Management Model (SWMM) to the city's problems. The project also sought to teach local research personnel how to handle the model. In order to obtain input data for model calibration, rainfall and runoff data from the Guereb-Roriche catchment which covers about 20 sq km, was used. Significant differences between Swedish and Tunisian urban areas coupled with climatic differences caused significant differences in the input parameters of the model. Also a lack of understanding of the 'modeling philosophy' and a lack of trained hydrologists who knew how to run the computer further complicated the use of the SWMM. Despite these problems, it was possible to reproduce the observed hydrographs quite well as long as the areal distribution of rainfall was taken into account.
W86-00087

MODELING WATER DEMANDS.
For primary bibliographic entry see Field 6D.
W86-00270

6B. Evaluation Process

CONDENSED DISAGGREGATION MODEL FOR INCORPORATING PARAMETER UNCERTAINTY INTO MOUTHLY RESERVOIR SIMULATIONS,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 2E.
W86-00073

NATIONAL WATER SUMMARY 1983--HYDROLOGIC EVENTS AND ISSUES.
Geological Survey, Reston, VA. Water Resources Div.
Available from Supt. of Documents, GPO, Washington, D.C. 20402. USGS Water-Supply Paper 2250, 1984. 243 p, 26 Fig, 9 Tab.

Descriptors: *National water assessment, *United States, *State water issues, *Hydrologic events, Water availability, Water quality, Hydrologic hazards, Land use, Institutional arrangements, Water management.

This national summary reviews current hydrologic conditions and recent events in the United States and provides a broad overview of the hydrologic issues facing the Nation. The summary also includes a description of water issues for each State, the District of Columbia, Puerto Rico, the U.S.

Virgin Islands, and the Western Pacific Islands under the jurisdiction of the United States. The State water-issue summaries were prepared by U.S. Geological Survey personnel in each of the States and are based on discussions with more than 130 State and local organizations. Taken together, these State summaries indicate the major similarities and differences in water issues facing different parts of the country. Major issues described include (1) the short-term vulnerability of surface-water supplies and shallow ground-water supplies to drought; (2) concerns about the reliability of water supplies as competition for water increases; (3) declining ground-water levels; (4) control of surface-water pollution, especially nonpoint sources of pollution; (5) contamination of ground-water supplies and the mitigation of existing sources of pollution, such as hazardous-waste sites; (6) the potential effects of acidic precipitation; (7) chronic problems of flooding; (8) the impacts of resource development, such as coal mining and low-head hydropower, on water resources; and (9) the development of water allocation and reallocation procedures. Hydrologic perspectives on these issues are discussed under the headings 'Water availability'; Water quality'; 'Hydrologic hazards and land use'; and 'Institutional and management'. (USGS)
W86-00131

ECONOMIC PERSPECTIVES ON ACID DEPOSITION CONTROL.

For primary bibliographic entry see Field 5G.
W86-00136

ECONOMICALLY RELEVANT RESPONSE ESTIMATION AND THE VALUE OF INFORMATION: ACID DEPOSITION,

Oregon State Univ., Corvallis. Dept. of Agricultural Economics.
R. M. Adams, and T. D. Crocker.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 35-64, 5 Tab, 37 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, *Water pollution effects, Precipitation, Economic aspects, Model studies, Mathematical models, Water pollution control, Sulfur oxides, Agriculture, Decision making, Policy making, Regulations, Water quality control.

The response of ecosystems to acid deposition and the applicability of such response measures to economic assessments were reviewed, and a decision theoretic framework was developed. The methods were applied to an agricultural problem using corn, soybeans, and cotton as examples. A numerical example compared four increasingly stringent regulatory policies from no standard (ambient oxidant standard of 0.18 ppm) to 0.08 ppm. Results were considered highly conditional. Any similar empirical assessment of response estimates would benefit from more comprehensive treatment of the economics of commodity demand and supply and better cost data, as well as a more complete statement of the decison making process of regulatory entities.
W86-00139

SCIENTIFIC TRUTHS AND POLICY TRUTHS IN ACID DEPOSITION RESEARCH,

Wyoming Univ., Laramie. Dept. of Economics.
T. D. Crocker.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 65-79, 36 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, Precipitation, *Water quality control, Economic aspects, Social aspects, Policy making.

The tradeoff of one set of socially nonoptimal biases in emitter and receptor behavior against another set implies that the total social costs of acid depositions may be nonmonotonic in the combination of the receptors' share of a realized environmental impact and in the critical values policymakers and researchers use to reject or to fail to reject hypotheses about cause-effect of source-cause linkages. For example, if emitters know they will be made responsible for only a minor portion of the cost consequences of a realized enviromental impact, a relatively coarse test for failing to reject either of the aforementioned linkages may have less total social cost than does a more discriminating test; the lesser emitter responsibility generates fewer emitter costs, while the less stringent critical values favor receptors. All this presumes that emitters and receptors perceive their interactions with the policymaker as being contingent on less-than-complete policymaker knowledge of cause-effect and source-cause linkages. The policymaker's choices of target levels for environmental response and emission controls, and the receptors' share directly influence emitter and receptor incentives and thus the total social costs of their activities. In a stochastic world in which emitters do not have to bear the full cost consequences of their activities, scientifically less-than-ideal hypothesis test procedures can desirably alter emitter and receptor investment incentives. Very lenient criteria for failing to reject the results on environmental impacts embodied in scientific reports can reduce the total social costs of acid deposition and their control. This result in no way depends on costly information acquisition for control costs or environmental impacts.
W86-00140

NORMATIVE ECONOMICS AND THE ACID RAIN PROBLEM,

Oklahoma Univ., Norman. Div. of Economics.
L. S. Eubanks, and R. A. Cabe.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 81-96, 17 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, Precipitation, Economic aspects, Water pollution control, Decision making, Policy, Water quality control, *Normative economics, Alternative planning, Planning, Legal aspects, Philosophy.

The scope of normative economics is limited in a way that excludes arguments that favor or oppose specific criteria for judging optimality. Politicians and philosophers are regarded to have expertise to make such arguments. It is unfortunate that standard practice of normative economics is almost exclusively associated with the study of only one criterion, the efficiency criterion. The implication of this is that normative economics as practiced has a very limited normative basis. This conclusion is illustrated clearly when a number of contributions to the philosophy literature are examined. It is not suggested that normative economics is of little use in policymaking, only that the self-delimited scope of normative economics should be understood in its proper perspective. The practice of normative economics has not been entirely true to its traditional definition because it is seldom interested in the study of criteria posing as alternatives to the criterion of efficiency. Certainly there is an enormous amount of interesting normative economic analysis, as traditionally defined, concerning alternative normative criteria. Normative economic analysis certainly has relevance to policymaking with respect to environmental problems such as acid rain, but perhaps only if it remains true to its defined scope and allocates its effort to the analysis of a much larger set of criteria for evaluating desirable resource uses. (Author)
W86-00141

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER UTILITY OPERATING DATA: AN ANALYSIS,

Ames, IA.
For primary bibliographic entry see Field 6D.
W86-00004

EFFECT OF GLOBAL OPTIMIZATION ON LOCALLY OPTIMAL POLLUTION CONTROL: ACID RAIN,

West Virginia Univ., Morgantown. Dept. of Economics.
S. Atkinson.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 21-33, 5 Tab, 11 Ref.

Descriptors: *Cost analysis, *Acid rain, *Air pollution, *Water quality control, Precipitation, Economic aspects, Model studies, Mathematical models, Water pollution control, Sulfur oxides, Ambient least-cost control, State Implementation Plans, Fate of pollutants, Cuyahoga County, Cleveland, Ohio.

The use of ambient least-cost systems (ALC) offered substantial savings over the State Implementation Plans (SIP) in attaining compliance with ambient air quality standards with respect to acid emissions from powerplants. Using data on a set of 25 sulfur dioxide sources in Cuyahoga County in the Cleveland region of the Ohio River Basin, mathematical modeling showed that the substantial cost savings of the ALC strategy over the SIP strategy (about $14 million) was largely due to the long-range transport of locally generated sulfur dioxide. When constraints on sulfur oxide transport were introduced, the cost savings (about $2.5 million) of the ALC strategy were almost neutralized. The question was raised whether the remaining differential was substantial enough to cover the additional administrative costs of the ALC system and outweigh concerns about equity losses.
W86-00138

ECONOMIC IMPACT OF ACID PRECIPITATION: A CANADIAN PERSPECTIVE,

Oklahoma Univ., Norman. Div. of Economics.
B. A. Forster.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 97-121, 3 Fig, 2 Tab, 49 Ref.

Descriptors: *Water pollution effects, *Acid rain, *Air pollution, Precipitation, *Economic aspects, Ontario, Canada, Lakes, Fishing, Recreation, Taxes.

This paper reviews (1) economic theory relevant to controlling transboundary air pollution and (2) knowledge on the dose-response relationship between acid deposition and physical impacts in the natural environment. This is related to the potential economic significance of acid deposition in eastern Canada. In agriculture and forestry the available dose-response information is insufficiently conclusive to estimate monetary values with confidence. Aquatic effects of acid deposition are better understood than most other effects. In Ontario 48,000 lakes are considered sensitive to acidification, which could impact sport fishing, an important component in the province's tourism and recreation industry. Intangible aspects of the environment may also be affected. The increased uptake of mercury by fish in acidified waters also poses a health risk to persons who consume these fish. A survey of taxpayers' willingness to pay additional taxes to improve the environment at different levels is as yet incomplete. This uses 10 levels of environmental conditions rather than dollar amounts of damages.
W86-00142

ACIDIFICATION IMPACT ON FISHERIES: SUBSTITUTION AND THE VALUATION OF RECREATION RESOURCES,

Clarkson Univ., Potsdam, NY. Dept. of Economics.
For primary bibliographic entry see Field 5G.
W86-00144

TRANSFERABLE DISCHARGE PERMITS AND PROFIT-MAXIMIZING BEHAVIOR,
Wyoming Univ., Laramie. Dept. of Economics.
For primary bibliographic entry see Field 5G.
W86-00145

6D. Water Demand

WATER UTILITY OPERATING DATA: AN ANALYSIS,
Ames, IA.
H. F. Seidel.
Journal of American Water Works Association, Vol. 77, No. 5, p 34-41, May, 1985. 1 Fig, 12 Tab, 14 Ref.

Descriptors: *Utilities, *Surveys, Water demand, Water distribution, Municipal water, Costs, Rural areas.

The analyses of data gathered in AWWA surveys in 1976, 1978, and 1980 are simple - consisting primarily of means, medians, and frequency distributions for common water utility parameters. Water use in gallons per capita per day (liters per capita per day) was on a stable plateau from 1970 to 1980, with mean and median values of about 160 and 150 gpcd (606 and 568 L/d per capita), respectively. Analysis of rural water districts as a separate class was made possible for the first time by their increased participation in the 1980 survey. Their per-capita water use was somewhat less than that of similar municipal utilities, whereas their rates were from one third higher to double, depending on the size of the rural district. For municipal utilities, water rates essentially doubled from 1970 to 1980, but this was still not enough to keep up with inflation during the decade. (Author's abstract)
W86-00004

PUBLIC WATER SUPPLIES IN GLOUCESTER COUNTY, N.J.,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2F.
W86-00174

PRESENT AND PROSPECTIVE USE OF WATER BY THE MANUFACTURING INDUSTRIES OF NEW JERSEY,
Illinois State Geological Survey Div., Champaign.
M. Grossman, and A. L. Sherman.
Water Resources Circular 11, June 14, 1963. 12 p, 1 Tab, 5 Exhibits.

Descriptors: *Water demand, *Water use, *Population dynamics, *New Jersey, *Future planning, Water requirements, Human population, Surveys, Water resources development.

The industries of New Jersey are increasing their use of publically supplied water. Planning for water requirements at least 20 yr in advance of actual need is recommended. In order to obtain, record and report data concerning water use by industry, a procedural manual should be prepared containing questionnaires for industries and managers of public supplies. A study of water use by all plants employing over 250 people is recommended for calendar year 1962. In addition, a survey of water use by all plants in one small New Jersey county is suggested. Population studies of New Jersey predicted an abnormally high increase in population in the suburban municipalities. Studies of employment showed that manufacturing, which is the principal industry of New Jersey, employs 50% of all those employed and uses about 90% of the water used by all industry.
W86-00175

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN: ECONOMIC AND SOCIAL IMPACTS OF GROUNDWATER CONTAMINATION; A CASE STUDY IN EAST BAY TOWNSHIP, GRAND TRAVERSE COUNTY, MICHIGAN.
Northwest Michigan Regional Planning and Development Commission, Traverse City.
For primary bibliographic entry see Field 5C.
W86-00218

WATER AND THE CITY,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
G. Lindh.
United Nations Educational, Scientific and Cultural Organization, Paris, France. 1983. 54 p.

Descriptors: *Urbanization, *Water demand, *Economic development, *Social impact, *Agriculture, Irrigation, Wastewater treatment, Water treatment, Planning, Environmental effects, Water supply, Water use, Saline soils, Groundwater, Rivers, Wells, Vegetation, Runoff, Urban runoff, Urban drainage, Floods, Subsidence, Storm water, Recharge, Public health, Combined sewers, Water transfer, Desalination.

This booklet traces the relationships between water and urban society from primitive times to the present and highlights some of the problems in water supply and quality. One of the major turning points in human history was irrigation, which was the beginning of food surpluses and the progression from farm to village to town to city to metropolis. In many regions of the world a water-demanding society has exploited water resources so that development costs rise dramatically. Early cultures, with few exceptions, have developed along rivers in Egypt, Mesopotamia, India, and China. However, some scholars postulate that water scarcity led to technological advances and improved agricultural practices. History records soil salination, pollution of watercourses with sewage and industrial wastes and other problems. The impact of city growth on water quantity and quality has increased with the size of cities and the loss of open land to building and paving. Urban flooding is an especially serious problem, destroying property and carrying pollutants. Water supply and wastewater treatment in developing countries and industrial regions are described. Examples of solutions are water transfer, reservoirs, seawater distillation, and individualized waste treatment and water pollution prevention schemes. As water demand increases, land subsidence and salt water intrusion increase. The importance of water planning and management is emphasized.
W86-00264

MODELING WATER DEMANDS.
Academic Press, New York, NY. 1984. J. Kindler and C.S. Russell, editors. 248 p, 205 Ref.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Municipal water, Economic aspects, Water management, Water requirements, Forecasting, Water supply, Water policy, Regional planning, Industrial water, Agriculture, Linear programming, Statistical models, Mathematical models.

This book presents the basic concepts and techniques of water demand modeling. Several case studies undertaken by the International Institute for Applied Systems Analysis are given. Most planning is based on demand (price dependent water use) rather than on requirement (irreducible water use). Statistical or engineering approaches to modeling are described, and examples of both are given. Modeling techniques are applied to three aspects of water use: industrial, agricultural, and municipal. Modeling is extended to the regional and national levels. Difficulties with the national-level models are highlighted. However, they can provide enough information to avoid truly enormous mistakes in water management, for example, an unnecessary interregional water transfer.
W86-00270

WATER DEMAND,
B. T. Bower, J. Kindler, C. S. Russell, and W. R. D. Sewell.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 1-22, 6 Fig, 1 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Prices, *Model studies, Economic aspects, Water management, Water requirements, Elasticity of demand, Water quality, Water rates, Water policy, Water supply, Consumptive use.

The introductory chapter to the book, 'Modeling Water Demands,' defines the water demand problem and introduces relevant terms. Some functions of water resources management are planning, design, construction, and operation. Analyses of water use problems are divided under three headings: (1) baseline forecasting, (2) predicting impacts of direct policy intervention and indirect impacts of related policies, and (3) balancing use and supply. Several terms used in the analysis of water demand are defined. Demand and requirement are often used interchangeably. However, demand denotes the willingness of consumers to purchase a product, depending on the price; requirement means the quantity purchased regardless of price. Elasticity of demand is the percentage by which the quantity demanded changes for a 1% change in the price. The price of water may be determined by the interaction of supply and demand or through administrative decisions. Six dimensions of water demand are mentioned; these include withdrawals, gross water used, consumptive use, discharge, wastewater services demanded, and time patterns for the preceding dimensions. Water demand also has temporal variation--day to day, seasonally, and year to year.
W86-00271

METHODOLOGICAL FRAMEWORK,
International Inst. for Applied Systems Analysis, Laxenburg (Austria).
J. Kindler, and C. S. Russell.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 23-50, 4 Fig.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, Economic aspects, Water management, Water requirements, Linear programming, Water supply, Statistical models, Mathematical models.

Two types of water demand modeling are described--statistical and engineering. The statistical approach views an activity (example, steel mill) as a black box with inputs and outputs, not considering the processes occurring within the activity. The engineering approach details the activity with individual unit processes. Modeling by the statistical approach involves several steps: choosing the model structure, i.e., selecting variables and hypothesizing structural relationships; choosing functional forms; estimating model parameters; verifying and validating the model; and using the model. Mathematical programming can be applied to the engineering approach. Linear programming is shown as an example. Whichever approach is used, the model is verified and validated. Verification is the determination of whether or not the correct model has been developed from a given single set of data describing water demand relations. Validation is testing of the model against one or more independent sets of data. Choice of model type depends on data availability, skills and interests of the modeling team, available computational facilities, and the intended application.
W86-00272

INDUSTRIAL WATER DEMANDS,
Operational Economics, Inc., Houston, TX.
J. C. Stone, and D. Whittington.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 51-100, 9 Fig, 3 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Industrial water, *Pulp and paper industry, *Electric power industry, Economic aspects, Water management, Water requirements, Linear programming, Water supply, Statistical models, Mathematical models, The Netherlands, Poland, Prices, Cooling water.

Two approaches to modeling industrial water demand relationships are discussed and illustrated. The statistical approach is used to model demands for the Dutch paper industry. It focused on estimating water demand relationships and gives a list

of some econometric problems most likely to be encountered. Statistical estimation in the industrial water sphere is in its infancy. Problems include small sample sized available, lack of necessary data, and the simultaneous determination of price and quantity of water. The mathematical programming approach is illustrated wtih a determination of the water demand for electricity generation in Poland. The discussion includes a general description of the structure and components of the mathematical model, the process of model construction and specification, and model use and results.
W86-00273

AGRICULTURAL WATER DEMANDS,

I. V. Gouevsky, and D. R. Maidment.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 101-147, 16 Fig, 5 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Agriculture, *Irrigation, Livestock, Cattle, Economic aspects, Water management, Water requirements, Linear programming, Water supply, Mathematical models, Crop production, Bulgaria, Wheat, SWIM 2 model.

Agricultural water demands in crop production and livestock production are individually discussed. Water demands of individual and regional agricultual activities are considered, using as an example a linear programming model with a one type crop (wheat), one type animal (cattle) system. Among the information that can be derived from this simple example are the demand function for total irrigation water withdrawals and the demand function for wastewater discharges. The water demands of a large agroindustrial complex in the Silistra region of Bulgaria is analyzed and forecasted using the SWIM 2 model.
W86-00274

MUNICIPAL WATER DEMANDS,

Johns Hopkins Univ., Baltimore, MD. Dept. of Applied Economics.
S. H. Hanke, and L. de Mare.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 149-169, 3 Fig, 8 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Municipal water, Industrial water, Water loss, Malmo, Sweden, Statistical models, Economic aspects, Water management, Water requirements, Elasticity of demand, Water rates, Water supply, Prices.

Municipal water uses may be grouped into six categories, based on the volumes of water and wastewater involved and the timing of their use. The categories are residential, industrial, commercial transportation, public, and lost and unaccounted for water. Residential water use may be over half of total municipal use in many communities. Statistics on mean residential water use for different activities, in different types of residences, and diurnal patterns are presented. Commercial water use is variable--20-55 liters per employee-day in offices, 100 liters per employee-day in businesses with dirty conditions, and up to 1900 liters per day per washing machine in a laundry. Water use in public service activities are 630 liters per day per patient in a hospital, about 300 liters per day per patient in psychiatric facilities and nursing homes, 55-75 liters per day per student in schools with showers and cafeteria, and up to 200 liters per day per user in swimming pools. Leakage and undermetering are responsible for much lost and unaccounted for water, up to 50% in some systems. Statistical methods have proved more suitable for modeling municipal water demands than the engineering approach. An example of statistical modeling is given for residential water demand in the city of Malmo, Sweden.
W86-00275

PROGRAMMING MODELS FOR REGIONAL WATER DEMAND ANALYSIS,

Resources for the Future, Inc., Washington, DC.
C. S. Russell.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 171-206, 11 Fig, 3 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Regional planning, Delaware Valley, Statistical models, Economic aspects, Water management, Water requirements, Industrial water, Water quality, Wastewater treatment, Water supply, Estuaries, Mathematical models, Linear programming.

The design and construction of regional water demand models uses mathematical programming models of individual water use activities, such as industrial, agricultural, and municipal. Since regional models can easily become enormous and complicated, techniques for size reduction and simplification are given. A regional modeling project involving the lower Delaware Valley is used as an example. Although it deals only with water quality and not quantity, many of the principles of model design and size reduction are illustrated. Since each region is unique, models must be custom-built. A handbook which combines standardized parts to produce a regional model is not yet available.
W86-00276

NATIONAL PERSPECTIVE IN WATER DEMAND MODELING,

International Inst. for Applied Systems Analysis, Laxenburg (Austria).
J. Kindler, and C. S. Russell.
In: Modeling Water Demands, Academic Press, New York, NY. 1984. p 207-219, 3 Fig, 2 Tab.

Descriptors: *Planning, *Water demand, *Water use, *Model studies, *Municipal water, Economic aspects, Water management, Water requirements, Forecasting, Water supply, Water policy, Regional planning.

Attempts to apply the concept of water demand to the national level are difficult and of limited relevance. Most work has been directed toward use rather than demand. Baseline forecasting, usually undertaken to identify problems before the crisis stage, is not too effective on a national basis. To get the best results, forecasting should be done on a regional basis with some consideration of upstream/downstream relations. Several national water studies are described. Poland has a long history of national water studies dating to 1953-56. A macro interregional linear programming model U.S. agriculture provides much information on least-cost distribution of agricultural production. A water use forecasting study done in Japan in the 1970s has five major components: a macroeconomic model-input-output model and four submodels (municipal, household, industrial, and agricultural). When national aggregated projections of water use are made, several problems develop. Possible intraregional problems are understated or eliminated. The models also overstate net withdrawal totals by ignoring reuse. If the water use exceeds the supply on a national basis, large and wasteful water supply projects or irrigation projects are often conceived without regard to regional conditions.
W86-00277

6E. Water Law and Institutions

NATIONAL WATER SUMMARY 1983--HYDROLOGIC EVENTS AND ISSUES.

Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W86-00131

ACID RAIN: DOES SCIENCE DICTATE POLICY OR POLICY DICTATE SCIENCE,

Georgia Univ., Athens. Inst. of Natural Resources.
J. L. Regens.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 5-19, 2 Tab, 48 Ref.

Descriptors: *Policy making, *Acid rain, *Water quality control, *Air pollution, Precipitation, Fallout, Monitoring, Sulfur oxides, Fate of pollutants, Model studies, Research priorities, Water pollution effects, Environmental effects, Economic aspects, Decision making, Public policy, Water pollution control.

Research can contribute significantly to reducing the current level of uncertainty about the causes and consequences of the acid deposition problem. However, science can never provide the last word with absolute certainty. Clearly, such a mission represents an impossible task, although research can be used to improve significantly the quality of information in areas important for decision-makers. Enhanced understanding of the causal factors and potential consequences of acid deposition enables policymakers to identify and select those courses of action which, given their own value systems, address most appropriately the problem. Thus, science neither dictates the policy nor policy the science. Instead, a symbiotic relationship exists between the two. Knowledge from one domain can foster choice in the other. (Author)
W86-00137

LEGAL, ETHICAL, ECONOMIC AND POLITICAL ASPECTS OF TRANSFRONTIER POLLUTION,

Resources for the Future, Inc., Washington, DC.
A. V. Kneese, and R. C. D'Arge.
IN: Acid Precipitation Series, Volume 8: Economic Perspectives on Acid Deposition Control, Butterworth Publishers, Boston. 1984. Volume edited by Thomas D. Crocker. Series edited by John I. Teasley. p 123-133, 1 Tab, 13 Ref.

Descriptors: *Political constraints, *International agreements, *Water pollution effects, Economic aspects, Legal aspects, Ethics, Efficiency, Jurisdiction, Liability, Negotiations.

Compensated and uncompensated transnational pollution problems have been analyzed. Compensation among nations is necessary to achieve economic efficiency, in that costs and benefits will be adequately compared. For many Western ethical criteria, uncompensated risks imposed by one nation on others could be unethical, but this depends on the ethical criterion as well as differences in income and other political considerations. Because of differences in the mix of ethical beliefs among nations along with the desire to maintain national sovereignty, no all-inclusive principle is likely to emerge to solve transnational pollution problems. What is likely to emerge is a sequence of relatively unique solutions that blend economic necessity with political cunning and goodwill. However, the first step appears to be that every nation agrees to negotiate in good faith toward a solution of transnational pollution provided there is sufficient evidence of economic benefit and cost. The record on international settlement of transnational pollution does not lead to a clear and concise set of guiding international principles. The various cases demonstrate the various possibilities ranging from full costing to victim pays. It is unlikely that such piecemeal solutions will lead to economic efficiency in a global sense. Yet, as long as there are gains from trade, including pollution, among nations, and these gains from trade are negotiated over and obtained, everyone should be as well off or better than without negotiation. (Author)
W86-00143

SURVEY OF NATIONAL AND STATE REGULATORY AGENCY POLICY AND PROCEDURES FOR THE DETERMINATION OF THE TOXICITY OF WASTEWATER EFFLUENTS.

Ecological Analysts, Inc., Sparks, MD.
API Publication 4353, American Petroleum Institute, Washington, DC., November 1982. 133 p, 1 Fig, 7 Tab, 6 Ref, 2 Append.

Descriptors: *Toxic wastes, *Public policy, *Water pollution effects, *Standards, *Wastewater management, *Toxicity, *Industrial wastes, Bioassay, Aquatic animals, Permits, State jurisdiction, Regulations, Oil refineries, Water policy, Surveys.

The U.S. EPA and state regulatory agencies use effluent toxicity testing on a case-by-case basis to

evaluate the acute toxicity of effluents. It appears likely that effluent toxicity testing, especially given the activities in U.S. EPA Region VI, and other water quality-based regulatory procedures will be used in upcoming years to help evaluate point source industrial discharges. The extent and degree to which this occurs will depend on the direction and guidance developed by U.S EPA in Washington, D.C., the specific U.S. EPA regional offices, and the individual states. Since use of effluent toxicity testing during the issuance of the second round of NPDES permits is dynamic, status of effluent toxicity testing in each state should be carefully investigated before making final environmental management decisions. (Author)
W86-00211

WATER AND THE CITY,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 6D.
W86-00264

OPPORTUNITIES TO PROTECT INSTREAM FLOWS IN ALASKA,
M. R. White.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-124974. FWS/OBS-82/33, July 1982. Fish and Wildlife Service, Washington, DC. Office of Biological Services. 30 p, 2 Tab, 45 Ref. Contract/Grant No. 14-16-009-79-100.

Descriptors: *Water law, *Water policy, *Alaska, *Water management, *Rivers, Instream flow, Fish, Aquatic life, Rivers, Resources management, Water use, Appropriation, Legal aspects, Legislation, Water rights, Permits, Land acquisition, Wildlife, Water resources.

This report, intended for the use of planning and management personnel, identifies and describes promising opportunities for protecting instream uses of water under existing Alaskan law. It is designed as a guide through the Federal and state statutes and administrative practices. Sections include Department of Natural Resources conditions on appropriative rights, reservation of instream flows, Department of Fish and Game acquisition of land and water, anadromous fish permits, pollution laws, municipal condemnation, Renewable Resources Fund, coastal zone management, Marine Fisheries Compact, and Public Trust Doctrine.
W86-00280

6F. Nonstructural Alternatives

FLOOD DAMAGE ALLEVIATION IN NEW JERSEY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
S. Dola.
Water Resources Circular 3, New Jersey State Dept. of Conservation and Economic Development, 1961. 20 p, 22 Ref.

Descriptors: *Flood plain zoning, *Flood plain management, *Flood control, *Flood damage, *New Jersey, Water resources development, Flood protection, Flood plains, Zoning.

New Jersey is faced with serious flood problems due to increasing population and development in flood prone areas such as the Passaic and Delaware river basins. Only through Federal participation in the construction of engineering structures such as dams and local protective works can future flood damage to existing developments be reduced. The U.S. Army Corp of Engineers is now compiling data on floods and flood damages to promote better zoning in the Passaic Valley. The U.S. Weather Bureau is conductng flood forecasting in the Delaware, Raritan, and Passaic river valleys. The Soil Conservation Service gives technical, cost-sharing, and credit aid to local organizations in planning and carrying out works of improvement for flood prevention, and agricultural and nonagricultural water management. The U.S. Geological Survey gathers data on floods by gaging streams throughout New Jersey. The municipal encroachment law permits municipalities to construct improvements, remove obstructions, define the location, establish widths, grades, and elevations of any stream and to prevent encroachments thereon of the flood carrying capacity to be provided. The 1929 Encroachment Law for flood damage alleviation in New Jersey is basically a preventive measure approach. The Tennessee Valley plan for flood plain regulation would divide the responsibility between state and local governments.
W86-00173

6G. Ecologic Impact Of Water Development

REVIEW OF THE EFFECTS OF WATER-LEVEL CHANGES ON RESERVOIR FISHERIES AND RECOMMENDATIONS FOR IMPROVED MANAGEMENT,
Fish and Wildlife Service, Fayetteville, AR. National Reservoir Research Program.
G. R. Ploskey.
Technical Report E-83-3, February 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 83 p, 203 Ref. Intra-Army Order WESRF-82-24.

Descriptors: *Reservoir fisheries, *Fish, *Water level, Water properties, Water level fluctuations, Reservoir releases, Water temperature, Reservoir operation, Ecosystems, Erosion, Turbidity, Chemical properties, Dissolved oxygen, Fish harvest, Nutrients, Flooding, Drawdown, Aquatic plants, Benthos, Spawning, Zooplankton, Literature review.

Information gathered from available literature sources about the physico-chemical and biological effects of water-level changes on reservoir ecosystems is summarized. The effects of variations in both the physical environment (i.e., basin morphometry, bottom substrates and structures, erosion turbidity, temperature, and water-retention time) and the chemical environment (i.e., nutrients and dissolved oxygen) caused by water-level changes on a reservoir's production of fish are described. The complex ways in which water-level changes affect aquatic plants, zooplankton, and the benthos and how these trophic variations can eventually affect the growth, reproduction, and harvest of fish are discussed. The final part of the report summarizes the effects of drawdown and flooding on reservoir fish populations and recommends ways to manage reservoir fluctuation zones by making controllable variables (magnitude, frequency, and timing of water-level change) as favorable as possible for fish survival, spawning, and feeding.
W86-00158

TECHNIQUES TO REDUCE THE SEDIMENT RESUSPENSION CAUSED BY DREDGING,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5G.
W86-00159

LONG-TERM IMPACT OF DREDGED MATERIAL AT TWO OPEN-WATER SITES: LAKE ERIE AND ELLIOT BAY; EVALUATIVE SUMMARY,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 5C.
W86-00160

FISHES OF SELECTED AQUATIC HABITATS ON THE LOWER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
C. H. Pennington, J. A. Baker, and C. L. Bond.
Technical Report E-83-2, January 1983. Final Report. 96 p, 22 Fig, 19 Tab, 39 Ref, Append.

Descriptors: *Environmental effects, *Aquatic habitats, *Fish, *Channel improvement, Mississippi River, Dikes, Stream banks, Banks, Erosion control, Revetments, Bank erosion, Flood control, Habitats, Aquatic animals.

Fish species diversity, abundance, and distribution were studied in four habitats (dike fields, revetted banks, natural banks, and an abandoned river channel) in the Lower Mississippi River near Greenville, Mississippi. The largest number of fish species was found in the dike field habitat (53), followed by the abandoned channel (31), revetted banks (27), and natural banks (24). Dike fields were similar at most sampling periods with respect to species composition but were often different in the relative abundances of the constituent species. The natural banks were generally similar in species composition and relative abundance, while the revetted banks showed greater variability and overall lower similarity. The numerical catch per unit effort was seldom significantly different among habitats. Catches on revetted banks were generally higher than on natural banks. In November 1979 the catch per unit effort was 7 times that of any other habitat. Biomass catch per unit effort was greatest in the revetted bank habitat, followed in order by dike fields, natural banks, and abandoned channel, with two exceptions. In April 1979 the biomass catch per unit effort in the abandoned channel was greater in dike fields and natural banks than in revetted banks; in November 1979 the biomass catch per unit effort was greatest in the abandoned channel. Condition factors were not significantly different among the habitats or seasons. Age 0 fish were abundant in dike fields and, to a lesser extent, in the abandoned channel. Mostly adult fish were collected at natural banks and revetted banks.
W86-00195

LARGE-SCALE OPERATIONS MANAGEMENT TEST OF USE OF THE WHITE AMUR FOR CONTROL OF PROBLEM AQUATIC PLANTS: THE HERPETOFAUNA OF LAKE CONWAY, SPECIES ACCOUNTS,
University of South Florida, Tampa. Dept. of Biology.
G. T. Bancroft, J. S. Godley, D. T. Gross, N. N. Rojas, and D. A. Sutphen.
Miscellaneous Paper A-83-5, July 1983. Final Report. U.S. Army Aquatic Plant Control Research program, Army Engineer Waterways Experiment Station, 304 p, 62 Fig, 42 Tab, 104 Ref, 2 Append.

Descriptors: *Weed control, *Environmental effects, *Aquatic weed control, *Wildlife, *Lakes, Aquatic animals, *Reptiles, *Amphibians, Snakes, Frogs, Turtles, Fish, White amur, Lake Conway, Florida, Ecosystems, Aquatic habitats, Habitats, Salamanders, Alligators.

Species accounts of the herpetofauna of Lake Conway, Florida, were developed to assess any changes resulting from use of the white amur to control aquatic plants. During 1977-1980 ecological were recorded for 2 of 4 salamanders, all 8 frogs, the American alligator, 5 of 10 turtles, and 1 of 7 snakes. The change most often noticed was a change in relative density, followed by seasonal activity, population structure, open water habitat use, food habits, and movement patterns. No yearly variation was detected in the use of specific littoral zone habitats, growth rates, or reproductive output per individual. The white amur was implicated in ecological changes in 1 salamander and 3 turtle species. This was related to macrophyte removal by the fish, combined with other disturbance phenomena: shoreline development, destruction or removal of individuals from the lake system, boat propeller mortality, investigator efforts, water level fluctuations, and weather conditions.
W86-00202

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 3: BENTHIC MACROINVERTEBRATE STUDIES PILOT REPORT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.

D. B. Mathis, S. P. Cobb, L. G. Sander, A. D. Magoun, and C. R. Bingham.
Miscellaneous Paper E-80-1, April 1981. Report 3 of a Series. 83 p, 12 Fig, 16 Tab, 8 Ref.

Descriptors: *Environmental effects, *Ivertebrates, *Waterways, *Aquatic habitats, Habitats, Missisippi River, Aquatic animals, Aquatic life, Macroinvertebrates, Benthos, Channels, Dikes, Sand, Banks, Stream Banks, Flow control, Caddisflies, Mayflies, Oligochaetes, Aquatic insects, Insects, Chironomids.

Benthic macroinvertebrates were sampled on the Lower Mississippi River, River Mile 480 to 530. A total of 20,562 organisms, representing 72 distinct taxa, 17 orders, and 5 classes were collected. The three most productive habitats were dike structures (563.4 organisms per rock sample), abandoned channels (70.04 organisms per 0.05 sq m), and natural banks (9.4 organisms per 0.05 sq m). The dike structures contained primarily caddisflies, chironomid larvae, and mayflies. Abandoned channels contained oligochaetes, dipteran larvae, and fingernail clams. Natural banks featured burrowing mayflies and clinging macroinvertebrates. These three habitats were relatively stable compared with the other less productive habitats, dike fields, revetted banks, permanent secondary channel, temporary secondary channel, main channel, and sand bars.
W86-00212

EFFECTS OF BEACH NOURISHMENT ON THE NEARSHORE ENVIRONMENT IN LAKE HURON AT LEXINGTON HARBOR (MICHIGAN),

Coastal Engineering Research Center, Fort Belvoir, VA.
R. T. Nester, and T. P. Poe.
Miscellaneous Report No. 82-13, November 1982. 56 p, 5 Fig, 10 Tab, 17 Ref, 5 Append. Project No. G31533.

Descriptors: *Environmental effects, *Erosion control, *Beaches, *Shore protection, *Lakes, Lake Huron, Lexington Harbor, Michigan, Benthos, Invertebrates, Fish, Water quality, Protection, Dredging, Bottom sediments, Suspended sediment, Turbidity.

A beach nourishment project at Lexington Harbor, Michigan, had no significant adverse effect on the nearshore aquatic environment, as determined by aerial photography, water analysis, and sampling of lake bottom sediments, macrozoobenthos, and fish. However, the beach face profile changed markedly during the 14-month study. By the end of the study, a moderate lakeward extension of the beach face was present in the area immediately south of the harbor.
W86-00224

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER: RIVER MILE 480-530; REPORT 6: LARVAL FISH STUDIES PILOT REPORT,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
H. L. Schramm, and C. H. Pennington.
Miscellaneous Paper E-80-1, April 1981. Report 6 of a Series. 74 p, 4 Fig, 29 Tab, 10 Ref.

Descriptors: *Environmental effects, *Aquatic habitats, *Fish, *Waterways, Habitats, Mississippi River, Aquatic animals, Aquatic life, Larvae, Channels, Dikes, Sand, Banks, Stream banks, Flow control, Oxbow lakes, Sampling, Diurnal distribution, Herring, Carp.

Larval fish were collected in 9 habitats in the Lower Mississippi River during the spawning season. Abandoned channels and oxbow lakes had relatively low diversity and high densities of clupeids and centrarchids. Natural banks and revetted banks had high density and abundance of larval fish. Dike fields had high diversity and moderate density of larval fish. Three of the four main channel sampling stations showed low diversity and density of larval fish. The fourth main channel had high diversity and high density on two sampling dates. In temporary secondary channels the density of larval fish was low and the diversity was high. Both density and diversity were low in the permanent secondary channel and in the sand bar. The number of taxa and the density of larvae were greatest at dusk. Twelve taxa were collected only at dusk, dawn, or at night. Samples taken within a 1- to 2-hour period of a diel cycle did not constitute significant amounts of the variation in number of taxa or density of larval fish. In addition, samples collected with paired nets did not constitute a significant portion of the variation in number of taxa but did constitute a significant portion of the variation in density.
W86-00226

FLOOD CONTROL MINNESOTA RIVER, MINNESOTA, MANKATO-NORTH MANKATO-LEHILLIER: DESIGN MEMORANDUM NO. 8, PART I (LOCATION STUDY).

Army Engineer District, St. Paul, MN.
For primary bibliographic entry see Field 8A.
W86-00238

GUIDE TO STREAM HABITAT ANALYSIS USING THE INSTREAM FLOW INCREMENTAL METHODOLOGY,

Fish and Wildlife Service, Fort Collins, CO. Western Energy and Land Use Team.
K. D. Bovee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-131052. Report No. FWS/OBS-82/26, June 1982. 249 p, 52 Fig, 31 Tab, 78 Ref, 2 Append.

Descriptors: *Environmental effects, *Streams, *Habitats, *Water analysis, *Aquatic life, Planning, Rivers, Instream Flow Incremental Methodology, Instream flow, Water yield, Sediment yield, Channel flow, Channeling, Water quality, Watersheds, Land use, Aquatic habitats, Aquatic animals, Reservoirs, Fish passages, Channel improvement, Hydrology, Water resources development.

The Instream Flow Incremental Methodology has been expanded and refined to produce an approach to the assessment of riverine habitats and the impact of disturbances on these habitats. The first chapters of this user's guide explain the overall approach of the methodology, describe activities that preceed data collection, show the sequence of data collection, and detail options for preparing, displaying, and interpreting the output. The later chapters contain necessary concepts of hydrology and channel dynamics and the Physical Habitat Simulation System. Stream habitat can be defined in terms of macrohabitat (temperature, water quality, sediment size and load, channel shape, slope, and flow regime) or microhabitat (distribution of depth, velocity, substrate, and cover within a specific area of the stream). Macrohabitat characteristics affect the longitudinal distribution of species and create longitudinal gradations in the microhabitat characteristics along the stream. The total habitat availability at any flow is defined by the area of overlap between suitable macrohabitat conditions and available microhabitat area. Total habitat may be determined with or without a project such as reservoir construction or channel improvement.
W86-00251

NORFOLK HARBOR AND CHANNELS DEEPENING STUDY, REPORT 1: PHYSICAL MODEL RESULTS, CHESAPEAKE BAY HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2L.
W86-00266

7. RESOURCES DATA

7A. Network Design

SYNTHESIS OF RADAR RAINFALL DATA,

National Weather Service, Silver Spring, MD. Hydrologic Research Lab.
For primary bibliographic entry see Field 2A.
W86-00084

7B. Data Acquisition

STREX TOVS/RADIOSONDE COMPARISON, PART I: TOVS/AVHRR AND RADIOSONDE INVENTORY,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
H. M. Byrne.
NOAA Data Report ERL PMEL-8, October 1982. 135 p, 3 Append.

Descriptors: *Remote sensing, *Satellite technology, *Radiosondes, *Meteorological data collections, STREX, NAVAID, TOVS, AVHRR, Measuring instruments.

This report consists of four appendixes of data generated in 110 overpasses of the NOAA-6 polar orbiter. Appendix A is a catalog of 123 computer-generated coverage maps of the overpasses. They show the coverage of the AVHRR scanner during the pass and the coverage of the TOVS instruments. Appendix B tabulates the STREX NAVAID radiosonde and aircraft dropsonde data taken during the experiment. Appendix C consists of lists of translated passes including orbit number, data, and time, and the archive tape label at the University of Miami. Appendix D is the tabulation of the NAVAID radiosonde computer printouts on microfiche.
W86-00187

ARCTIC MARINE OILSPILL PROGRAM (AMOP) REMOTE SENSING STUDY,

Canada Centre for Remote Sensing, Ottawa (Ontario).
R. A. O'Neil.
Report EPS 4-EC-83-3, March 1983. Environmental Protection Service, Ottawa, Ontario. 257 p, 103 Fig, 6 Tab, 79 Ref, 10 Append.

Descriptors: *Remote sensing, *Satellite technology, *Path of pollutants, *Oil spills, Arctic, Cold regions, Ice, Oil slicks, Canada, Arctic Marine Oilspill Program, Radar, Television, Photography, Infrared imagery, Kurdistan, Nova Scotia, Montreal Harbor, Scott Inlet, Data aquisition.

The Arctic Marine Oilspill Program studied remote sensing of oil slicks on ice-infested waters. Experiments were conducted in Montreal Harbor, Scott Inlet, off the New Jersey coast, and off the Nova Scotia coast (Kurdistan spill). A recommended integrated sensor package included a side-looking radar, an ultraviolet-infrared dual channel line scanner, a laser fluorosensor, a low-light-level television, and annotated photographic cameras. A real-time display system was recommended to allow operator interaction with the sensors.
W86-00258

BOULDER UPSLOPE CLOUD OBSERVATION EXPERIMENT.

National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Research Labs.
For primary bibliographic entry see Field 2B.
W86-00261

USE OF SATELLITE IMAGERY FOR TRACKING THE KURDISTAN OIL SPILL,

Remotec Applications Ltd., St. John's (Newfoundland).
B. R. Dawe, S. K. Parashar, J. P. Ryan, and R. D. Worsfold.
Report EPS 4-EC-81-6, December 1981. Environmental Protection Service, Ottawa, Ontario. 31 p, 19 Fig, 3 Tab, 10 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Oil spills, Oil slicks, Kurdistan, Path of pollutants, LANDSAT, TIROS, Ice, Cape Breton Island, Infrared imagery.

The effectiveness of using satellite imagery in locating, monitoring, and tracking oil spills in open water was studied after the tanker Kurdistan broke in two pieces in ice off Cape Breton Island on March 15, 1979. The accident released 7000 metric tons of Bunker C oil. Results of the study were inconclusive. A major oil slick was located on only one occasion. At this time only TIROS AVHRR imagery with a reduced dynamic range (2 significant bits missing) was available. All other TIROS and LANDSAT data had no confirmed slicks within the imaged areas. Sun elevations and wind speeds were unfavorable for detection of oil slicks by satellite imagery. However, LANDSAT data detected a confirmed oil-on-ice slick in Gabarouse Bay. Band 4 provided the best contrast, whereas Band 7 was the worst. TIROS imagery over an oil-ice area did not detect an oil slick.
W86-00291

7C. Evaluation, Processing and Publication

MONITORING OF RESERVOIR VOLUME USING LANDSAT DATA,

Roorkee Univ. (India). Dept. of Earth Sciences.
R. P. Gupta, and S. Banerji.
Journal of Hydrology, Vol. 77, p 159-170, 1985. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Reservoir storage, *Remote sensing, *Landsat, *Satellite technology, *Ramganga dam reservoir, *India, Mountain lakes, Water depth, Topography, Lake morphology, Lake morphometry.

Measuring depth of a water body by remote sensing is limited by several factors such as turbidity, depth of water, type of bedrock material, wavelength used, etc. Measurement of width, length and area of a reservoir can be done rather easily with the help of satellite data. The accuracy of areal estimation is limited by the areal resolution of the sensor and topographic milieu. Computing lake surface area for estimating water volumes would have limited applicability in areas of high topographic relief. A method which was suggested by others and involves marking of land-water contact from satellite data along low-gradient channels was applied to the Ramganga dam reservoir (Himalayas, India) using Landsat MSS CCT's, field spectro-radiometric measurements and theodolite surveys. The technique can be utilized in areas of known topography for real-time remote monitoring of fluctuations in reservoir volume. The elevation data obtained are very close to the recorded water level; taking design data as the standard data gives + or - 0.24% accuracy. For the sake of comparison, an attempt was also made to compute water volume by measuring lake surface area from the satellite data. The area of the reservoir can be measured upto an accuracy of + or - 5.14%. Some element of inaccuracy in measuring reservoir surface area could be due to rugged relief and shadows. (Collier-IVI)
W86-00032

WATER RESOURCES DATA FOR FLORIDA, WATER YEAR 1981 VOLUME 1: NORTHEAST FLORIDA.

Geological Survey, Orlando, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-170753. USGS Water Data Report FL-81-1, 1982. 591 p, 34 Fig, 1 Tab.

Descriptors: *Florida, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections.

Water resources data for the 1981 water year in Florida consists of continuous or daily discharge for 279 streams, periodic discharge for 52 streams, continuous or daily stage for 64 streams, periodic stage for 82 streams, peak discharge for 78 streams and peak stage for 55 streams; continuous or daily elevations for 77 lakes, periodic elevations for 144 lakes; continuous ground water levels for 483 wells, periodic ground water levels for 661 wells, and miscellaneous water level measurements for 2,807 wells; quality of water data for 301 surface water sites and 842 wells. The data for northeast Florida includes continuous or daily discharge for 57 stream, periodic discharge for 6 streams, miscellaneous discharge for 62 streams, peak discharge for 29 steams, low-flow discharge for 2 streams, continuous or daily stage for 28 streams; continuous elevations for 20 lakes and periodic elevations for 30 lakes; continuous ground water levels for 31 wells, periodic ground water levels for 116 wells, and miscellaneous water level measurements for 636 wells; quality of water for 80 surface water sites and for 702 wells. (USGS)
W86-00127

WATER RESOURCES DATA FOR COLORADO, WATER YEAR 1982, VOLUME 2. COLORADO RIVER BASIN ABOVE DOLORES RIVER,

Geological Survey, Lakewood, CO. Water Resources Div.
R. C. Ugland, J. T. Steinheimer, J. L. Blattner, and R. G. Kretschman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-120138. USGS Water Data Report CO-82-2, 1983. 339 p, 6 Fig, 5 Tab. Prepared in cooperation with the State of Colorado and other agencies.

Descriptors: *Colorado, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Colorado River basin.

Water-resources data for Colorado for the 1982 water year consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes, and reservoirs, and water levels and water quality of wells and springs. This report (Volumes 1, 2, and 3) contains discharge records for 408 gaging stations, stage and contents of 27 lakes and reservoirs, 6 partial-record low-flow stations, peak-flow information for 30 crest-stage partial-record stations, and 50 miscellaneous sites; water quality for 163 gaging stations and 245 miscellaneous sites; and water levels for 55 observation wells. Nine pertinent stations in bordering States are also included in this report. The records were collected and computed by the Water Resources Division of the U.S. Geological Survey under the direction of J. F. Blakey, District Chief. (USGS)
W86-00128

WATER RESOURCES DATA, NORTH DAKOTA, WATER YEAR 1981, VOLUME 1. HUDSON BAY BASIN.

Geological Survey, Bismarck, ND. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83 213785. USGS Water Data Report ND-81-1, 1982. 325 p, 7 Fig.

Descriptors: *North Dakota, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections, Hudson Bay basin.

Water resources data for the 1981 water year for North Dakota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. Volume 1 of this report contains 67 gaging stations; stage only records for 6 gaging stations; stage and contents for 4 lakes and reservoirs; water quality for 24 gaging stations; 10 partial-record stations, 14 lakes, 26 wells, and water levels for 19 observation wells. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. (USGS).
W86-00129

WATER RESOURCES DATA HAWAII, OTHER PACIFIC AREAS, WATER YEAR 1981. VOLUME 2. GUAM, NORTHERN MARIANA ISLANDS, FEDERATED STATES OF MICRONESIA, PALAU ISLANDS AND AMERICAN SAMOA.

Geological Survey, Honolulu, HI. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83 171116. USGS Water-Data Report HI-81-2, 1982. 148 p, 16 Fig.

Descriptors: *Pacific area, *Hydrologic data, *Surface water, *Groundwater, *Water quality, *Flow rate, Gaging stations, Chemical analyses, Sediments, Reservoirs, Water temperatures, Sampling sites, Water levels, *Data collections.

Volume 2 of water resources data for the 1981 water year for other Pacific areas consist of records of stage, discharge, and water quality of streams; stage of a reservoir; and water levels in wells and springs. This report contains discharge record for 41 gaging stations; stage only record for 2 gaging stations; water quality for 3 gaging stations, 39 partial-record stations; water temperature for 60 gaging stations; and water levels for 10 observation wells. Also included are 47 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. (USGS).
W86-00130

SEDMNT: A SEDIMENT TRANSPORT SUBMODEL BASED ON HYDRODYNAMIC PRINCIPLES FOR THE UNIFIED TRANSPORT MODEL,

Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 2J.
W86-00155

FOUNDATIONS OF PRINCIPAL COMPONENT SELECTION RULES,

Scripps Institution of Oceanography, La Jolla, CA.
R. W. Preisendorfer, F. W. Zwiers, and T. P. Barnett.
SIO Reference Series 81-4, May 1981. 192 p, 37 Fig, 33 Tab, 75 Ref.

Descriptors: *Data processing, *Data interpretation, *Model studies, *Temperature, Air temperature, Meteorology, Principal component analysis, Mathematical studies.

The problem of separating signal from noise in a given space-time data set of geophysical fields which has been rendered into its principal component representation is considered. These separations are effected by two main sets of selection rules: dominant-variance and time-history. The dominant-variance rules are based on the fact that the covariance matrix of the sum of a signal and a noise data set generally have a recognizably different eigenvalue curve than that of each of the two summands so that, under hypothesized noise and sampling conditions, the presence of a signal can be inferred with a chosen level of confidence. The time-history rules are based on the temporal evolution of the given data set's principal component series, and test the hypothesis that the series are of a given noise type. A rejection of the hypothesis about a particular component series at a given level of confidence results in the selection of the principal component as potentially signal-like. Nine dominant-variance rules and eight time-history rules were tested. Methods of interpreting principal component representations of data sets are given. Suggestions are also given for associating possible underlying dynamical models to these representations.
W86-00186

8. ENGINEERING WORKS

8A. Structures

OPTIMAL URBAN WATER DISTRIBUTION DESIGN,

MacLaren Engineers, Winnipeg (Manitoba).
For primary bibliographic entry see Field 5F.
W86-00071

WEIR JETTY PERFORMANCE: HYDRAULIC AND SEDIMENTARY CONSIDERATIONS, HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. C. Seabergh.
Technical Report HL-83-5, March 1983. Final Report. 298 p, 43 Fig, 3 Tab, 59 Photos, 105 Plates, 32 Ref, 2 Append.

Descriptors: *Performance evaluation, *Jetties, *Hydraulic models, Tidal rivers, Sediment transport, Tidal hydraulics, Flood flow, Ebb flow, Sediment control.

This study was performed to quantify the design parameters of an efficient sediment-handling weir jetty system. A 150-ft by 350-ft facility, yielding a 1:100 scale, in which the bay area was either partially filled (low Keulegan K value) of nearly filled (high Keulegan K value), was used to provide extremes of velocity-tidal elevation flow relationships over the weir. Sediment tracers and a movable-bed beach section provided the means to examine the deposition. Results indicate the mean tidal level weir elevation is the most practical elevation for providing wave protection for a dredge, good sediment transport across the weir, and good flood-ebb tidal flow relationships. Strong ebb flow currents over the weir are not desirable as they might aid in migration of the navigation channel through the deposition basin. Jetty systems with the outer, more oceanward portions parallel to each other and at minimum spacing provide the best flow characteristics when tidal current migration through the deposition basin region is considered. Wave-generated currents upcoast of the weir jetty are not entirely captured by the weir but some current, and thus sediment, moves oceanward along the outer portion of the jetty. Also, reflected waves off the jetty and weir structure combine with incident waves to form a short-crested wave field which aids in removal of sediment from the upcoast beach, to various degrees, depending on the structure's angle with respect to the shoreline and the incident wave angle. The effects of groins adjacent to the weir section were examined with regard to providing additional fillet storage and reducing the sediment movement in an oceanward direction along the jetty. Positive results were found for each variation tested.
W86-00152

BARCELONA HARBOR, NEW YORK, DESIGN FOR HARBOR IMPROVEMENTS: HYDRAULIC MODEL INVESTIGATION,

Coastal Engineering Research Center, Vicksburg, MS.
R. R. Bottin.
Technical Report CERC-84-3, August 1984. Final Report. 290 p, 6 Fig, 25 Tab, 134 Photos, 28 Plates, 15 Ref, 3 Append.

Descriptors: *Hydraulic models, *Harbors, *Docks, Wave action, Wave height, Barcelona Harbor.

A 1:60-scale (undistorted) hydraulic model of Barcelona Harbor, New York, including approximately 7,000 ft of the New York shoreline and sufficient offshore bathymetry in Lake Erie to permit generation of the required test waves, was used to investigate the design of certain proposed improvements with respect to wave action. Proposed improvements consisted of: (1) rubble-mound breakwater extensions, (2) rubble-mound absorbers installed along the harbor sides of the existing east and west break-waters and the lakeward face of the city dock, (3) rubble-mound spurs installed southerly of the lakeward heads of the existing breakwaters, and (4) a parapet wall installed on the existing west breakwater. Two 60-ft-long wave generators and an Automated Data Acquisition and Control System were utilized in model operation. An optimum improvement plan was selected based on the results of wave-height tests using monochromatic waves and spectral wave tests.
W86-00157

NAVIGATION CONDITIONS IN VICINITY OF WALTER BOULDIN LOCK AND DAM COOSA RIVER PROJECT: HYDRAULIC MODEL INVESTIGATION,

Geological Survey, Reston, VA.
C. Myrick, and J. J. Franco.
Technical Report HL-84-11, December 1984. Final Report. 129 p, 16 Fig, 5 Tab, 77 Plates.

Descriptors: *Locks, *Navigation, *Hydraulic models, *Model studies, Models, Navigation canals, Navigation obstructions, Simulation analysis, Design criteria, Surges.

The Walter Bouldin Lock will be the first navigation lock proposed for development of navigation on the Coosa River Waterway. The lock will be located in the left overbank area of Walter Bouldin Dam. Three fixed hydraulic models were used to examine navigation conditions in the reach in areas where difficulties were expected. Results showed that no serious navigation problems should arise in the Jordan Reservoir and in the entrance to the diversion canal. Navigation conditions could be hazardous through the Bouldin reservoir when the pool is below elevation 248.00 ft. due to high velocities and crosscurrents. Tows with sufficient power to overcome the high velocity currents could negotiate the powerhouse tailrace and lower lock approach channel without serious difficulties. Lock emptying and start up of powerhouse units would create surges that would be hazardous to navigation within the lock approach channel and in the reach downstream to below the confluence of the tailrace and the Alabama River. Surges hazardous to navigation could also develop when closing down one or more powerhouse units.
W86-00171

NAVIGATION CONDITIONS AT MITCHELL LOCK AND DAM, COOSA RIVER, ALABAMA,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
C. M. Myrick.
Technical Report HL-84-12, December, 1984. Final Report. 70 p, 14 Fig, 9 Tab, 31 Plates.

Descriptors: *Locks, *Model studies, *Design criteria, *Navigation, Structural models, Models, Planning, Structural engineering, Dams, Hydraulic structures, Gates, Hydraulic gates.

A fixed-bed model reproducing about 4 miles of the Coosa River and adjacent overbank areas to an undistorted scale of 1:120 was used to provide data on navigational conditions with the proposed lock (Mitchell Lock). Results of the study showed that with medium to high flows, navigation conditions at the Highway 22 Bridge would be hazardous for both upbound and downbound tows due to the high velocities and limited width provided through the navigation span with the existing piers and low superstructure. With the first and second lock alignments, navigation conditions were acceptable with the 35,000 cu ft/sec flow only. With the third lock alignment, navigation conditions were acceptable for all flows evenly distributed through the gated dam up to and including the 90,000 cu ft/sec flow. Flows unevenly distributed through the gated dam could cause navigation problems in the lower pool. Navigation conditions would be hazardous for tows in the upper lock approach canal during lock filling or at the end of the lower guard wall when emptying the lock into the lower approach with no riverflow. This problem could be eliminated by a riverflow of 35,000 cu ft/sec or by emptying the lock into the river.
W86-00177

PROGRAM CRITERIA SPECIFICATIONS DOCUMENT: COMPUTER PROGRAM TWDA FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS,

Army Engineer Div. Lower Mississippi Valley, Vicksburg, MS.
V. M. Agostinelli, W. A. Price, and C. E. Pace.
February 1981. Final Report. 217 p, 10 Fig, 12 Exhibits.

Descriptors: *Structural engineering, *Soil mechanics, *Computer programs, *Design criteria, *Retaining walls, Walls, Load distribution, Stability analysis, Earth pressure, Soil pressure, Hydrostatic pressure, Seepage, Soil properties, Shear, Friction, Compressive strength, Earthquake engineering, Seismic properties, Water pressure, Reinforced concrete, Concrete, Stress, TWDA program.

This document presents criteria prepared as the basis for developing TWDA (T-wall design/analysis), a computer program for design and analysis of inverted-T cantilever walls founded on earth or rock. These structures can act as floodwalls or retaining walls. The program is a series of design or analysis modules, each performing one specific step. Data are of two types: basic and load case. Stability criteria are the most uncertain and among the most important data used in design of an inverted-T wall. Other criteria are applied pressures (earth, overturning and sliding, hydrostatic, surcharge, and seepage), overturning stability, sliding, bearing pressures, earthquake analysis, and structural design (stress, reinforcing steel, stem loadings).
W86-00193

CLEVELAND HARBOR, OHIO: DESIGN FOR THE SAFE AND EFFICIENT PASSAGE OF 1,000-FT-LONG VESSELS AT THE WEST (MAIN) ENTRANCE, HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Bottin.
Technical Report HL-83-6, March 1983. Final Report. 346 p, 8 Fig, 34 Tab, 170 Photos, 20 Plates, 21 Ref, 2 Append.

Descriptors: *Breakwaters, *Navigation, *Waves, Cleveland Harbor, Ohio, Lake Erie, Model studies, Hydraulic models, Water currents, Channel improvement, Transportation, Ships.

A 1:100-scale hydraulic model of Cleveland Harbor, Ohio, was used to investigate the effects of proposed improvements on ship maneuverability, wave and current action, and river flow conditions. Proposed changes included removal of portions of the existing breakwater spurs, deepening and widening of the existing channel, installation of additional breakwaters, and modifications of existing arrowhead breakwaters. Results indicated that existing conditions are characterized by rough and turbulent waves during storms, making the west entrance unsafe for 1000-ft long ore carriers. For safe passage of the 100-ft ships in fair weather, the east and west breakwater spurs should be reduced in length by 200 ft and 300 ft, respectively. However, this alteration would increase wave heights in the Lakefront Harbor. The optimum crest elevation of the west arrowhead breakwater should be 14 ft (10 ft if the structure is sealed). The optimum plan for severe weather conditions (thus for all wave conditions) consisted of removal of 300 ft of the existing west spur breakwater and 200 ft of the existing east spur breakwater, 1000-ft parallel extension of the east and west arrowhead breakwaters.
W86-00204

CHANNEL CONTROL STRUCTURES FOR SOURIS RIVER, MINOT, NORTH DAKOTA: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
P. A. Saunders, and J. L. Grace.
Technical Report HL-81-3, April 1981. Final Report. 57 p, 9 Fig, 1 Tab, 17 Photos, 16 Plates.

Descriptors: *Hydraulics, *Erosion control, *Channels, *Gabions, Riprap, Model tests, Hydraulic models, Souris River, North Dakota, Ice, Flow characteristics, Bank stabilization.

Model tests of channel control structures constructed of concrete and gabions were conducted at an undistorted scale ratio of 1:12 to determine the discharge characteristics of the structures, size and extent of riprap required to prevent scour downstream of the structures, effects of ice flowing over the structures, and stability of the gabion structures. The gabion structure was located in a typical section of trapezoidal channel, and a stable gabion configuration was developed by extending the gabions farther up the side slopes and farther downstream of the structure than was indicated in the original design. The concrete structure was placed in an expanded section of trapezoidal channel with riprap protection on the slide slopes and on the channel bottom upstream and downstream of the structure. Model results indicated that the original size and extent of protection could be reduced without endangering the structure. Free and submerged flow discharge characteristics were determined for both types of channel control structures tested, and stability criteria were developed for the gabion structures. (Author)
W86-00209

TECHNIQUE TO OPTIMALLY LOCATE MULTILEVEL INTAKES FOR SELECTIVE WITHDRAWAL STRUCTURES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
M. S. Dortch, and J. P. Holland.
Technical Report HL-84-9, November 1984. Final Report. 34 p, 11 Fig, 4 Tab, 5 Plates, 8 Ref, Append.

Descriptors: *Hydraulic structures, *Dams, *Reservoirs, *Outlets, *Intakes, *Water quality control, Optimization, Mathematical models, Model studies, Beltzville Dam, Design criteria.

A systematic procedure is given for designing an optimum selective withdrawal intake configuration for a reservoir outlet works. A reservoir thermal simulation model was coupled with a mathematical optimization algorithm to develop the optimal vertical placement of intakes and to minimize the total number of intakes. The simulation/optimization technique was applied to a specific case: the selective withdrawal intake structure at Belzville Dam on the Pohopoco Creek, Pennsylvania. Two mathematical optimization techniques were tested. The cyclic coordinate search with the Golden Section line search proved more suitable than Powell's method.
W86-00213

FLOOD CONTROL MINNESOTA RIVER, MINNESOTA, MANKATO-NORTH MANKATO-LEHILLIER: DESIGN MEMORANDUM NO. 8, PART I (LOCATION STUDY).

Army Engineer District, St. Paul, MN.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA-120868. Main Street Trunk Highway 60 Bridge over the Minnesota River between Mankato and North Mankato. Includes the Draft Supplement to the Final Environmental Impact Statement for Bridge Locations. June 1981. 294 p, 10 Fig, 13 Tab, 5 Append.

Descriptors: *Hydraulic structures, *Environmental effects, *Bridges, *Flood control, Highways, Minnesota River, Mankato, Socal impact, Minnesota.

Flood control works are being constructed on the Minnesota and Blue Earth Rivers, Minnesota, to protect developed portions of Mankato, North Mankato, and Le Hillier from frequent flood damage. This report details the engineering studies for the modification to the Main Street bridge, which must be raised or replaced to an elevation of 30 ft above the existing bridge. The tentative plan would produce adverse neighborhood impacts in Mankato.
W86-00238

WAVE STABILITY STUDY OF RIPRAP-FILLED CELLS: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
D. G. Markle.
Miscellaneous Paper HL-83-2, April 1983. Final Report. 59 p, 43 Fig, 1 Tab, 18 Plates.

Descriptors: *Erosion control, *Soil mechanics, *Riprap, *Wave action, *Bank protection, Bank stabilization, Stream stabilization, Hydraulic models, Model studies, Wave runup.

Both two-dimensional and three-dimensional hydraulic model investigations were conducted to test the stability of a new streambank protection concept when exposed to short-period wave attack. The concept, referred to as 'Riprap-Filled Cells,' consists of containerizing riprap in various sizes of cells. Based on the 1:4-scale (model:prototype) model tests and results for the 'riprap-filled cells' placed on IV-on-2H streambank slopes that are assumed to be stable and impermeable and for angles of wave attack of 90, 60, and 30 degrees, it is concluded that: (a) one-ft-cube cells (full and half-full of 0.6- to 4.6-lb riprap) are stable (no streambank exposure) for 2.0-sec, 1.0- to 1.75-ft, 4.0-sec, 1.0- to 3.0-ft, and 6.0-sec, 1.0- to 2.5-ft nonbreaking waves; (b) rectangular cells (half-full of 0.6- to 4.6-lb riprap) are stable for nonbreaking wave heights up to and including 1.5 ft for wave periods of 2.0 and 6.0 sec. Wave heights exceeding this produce spot exposures of the streambank; (c) rectangular cells (full of 0.6- to 4.6-lb riprap) are stable for 6.0-sec, nonbreaking waves up to and including, 2.0 ft. Wave heights exceeding 2.0 ft produced spot exposures of the streambank; (d) both runup and rundown on all sections tested appear to be functions of wave steepness, relative depth, and angle of wave attack. The angles of wave attack, listed in descending magnitudes of runup and rundown produced, are 60, 90, and 30 degrees. One-ft-cube cells, full of riprap, and rectangular cells, half-full of riprap, show trends of decreasing runup and rundown with increasing values of wave steepness and relative depth. Insufficient data are available for these trends to be well defined for the 1-ft-cube cells, half-full of riprap and the rectangular cells, full of riprap. (Author)
W86-00283

8B. Hydraulics

B-JUMPS AT ABRUPT CHANNEL DROPS,

Ecole Polytechnique Federale de Lausanne (Switzerland). Chaire de Constructions Hydraulics.
W. H. Hager.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 861-866, May, 1985. 6 Fig, 7 Ref.

Descriptors: *Hydraulic jump, *Pressure distribution, Channel flow, Channels, Fluid mechanics, Stilling basins, Mathematical equations.

Hydraulic jumps are one of the most frequently used energy dissipators. Its simplest form, the palne hydraulic jump occurs in rectangular, prismatic, and almost horizontal channels. Whenever using hydraulic jumps as a kinetic energy dissipator, one has to control carefully its stability under all possible flow conditions, which may be achieved by stilling basins, by which the jump is forced to appear at a particular location. B-jumps in rectangular, prismatic stilling basins consisting of an abrupt drop of the channel bottom are investigated by accounting for the effective pressure distribution and the internal flow process. The traditional approach is modified to yield a more accurate relation for the conjugate flow depths. An equation is proposed which agrees favorably with observations when the pressure distribution at the drop is properly accounted for. (Baker-IVI)
W86-00018

WATER SURFACE AT CHANGE OF CHANNEL CURVATURE,

Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Steffler, N. Rajaratnam, and A. W. Peterson.
Journal of Hydraulic Engineering, Vol. 111, No. 5, p 866-870, May, 1985. 1 Fig, 4 Ref.

Descriptors: *Hydraulic engineering, *Water surface, *Channel flow, *Curves, Froude number, Channels, Model studies, Open channels.

In most work on the problem of flow in curved open channels, the lateral water surface slope has been assumed to be an algebraic function of the local channel curvature. Inspection of experimental water surface profiles indicates that an adjustment length in the order of the channel width is required where the curvature changes abruptly. A simple model is presented for the water surface configuration in the vicinity of an abrupt change in channel curvature taking free surface effects into account. The flow is assumed frictionless and the curvature is assumed mild. A simple expression for the length of such a transition as a function of Froude number has also been presented. The predicted water surface topography was shown to agree reasonably well with a few preliminary experiments. (Baker-IVI)
W86-00019

STORM SEWER OPTIMUM DESIGN,

D. Hoang.
In: Proceedings of Stormwater and Water Quality Model User Group Meeting, January 27-28, 1983, University of Florida, Gainesville. p 272-280, 1 Fig, 3 Tab.

Descriptors: *Storm sewers, *Design criteria, *Models, *Optimization, *Hydraulic models, *Sewer systems, *Cost-benefit analysis, *Hydraulic design, Model studies, Comparison studies, Sewers, Hydrographs, Runoff, Infiltration, Design Flow.

The STORM SEWER OPTIMUM DESIGN is a computer model which provides a fast means for estimating the optimum sewer system features for the least construction costs. The model is composed of a hydrograph computation compartment and design-flow compartment which coordinate to fully utilize the final sewer system. The OPTIMUM DESIGN method uses the real rainfall in selecting design and calculates the costs of sewer components to make cost-benefit analyses of alternative routes easy and effective. The model contains features for the automatic numbering of manholes and sewer lines and for the extension of existing sewer sytems to make storm sewer design more flexible. The OPTIMUM DESIGN method can accommodate users with less extensive engineering backgrounds than usually required of users of the Rational Method for storm sewer design.
W86-00100

POINTE COUPEE PUMPING STATION SUMP AND OUTLET STRUCTURE, UPPER POINTE COUPEE LOOP AREA, LOUISIANA: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8C.
W86-00101

ENERGY LOSSES AT STRAIGHT-FLOW-THROUGH SEWER JUNCTIONS,

National Water Research Inst., Vancouver (British Columbia).
J. Marsalek.
Environment Canada, Canada-Ontario Agreement on Great Lakes Water Quality, Research Report No. 111, 1981. 29 p, 9 Fig, 4 Tab, 13 Ref.

Descriptors: *Energy loss, *Sewer hydraulics, *Sewer systems, *Manholes, *Flow velocity, *Flow characteristics, *Pipe flow, *Hydraulics, Energy dissipation, Mathematical studies, Channel flow, Pipes, Pipelines.

Energy losses at straight-flow-through sewer junctions with free water surface were found to be considerably less than those in fully-pressurized pipe junctions without the free water surface. Mean energy losses observed for open-channel junctions were less than those for the same junc-

tions operating under pressure. There were only small differences in energy losses between square and circular manholes. Energy losses were less in manholes with installed benching. The junction energy loss coefficient was nearly doubled for manholes with pressurized flow and nearly halved for manholes with a benching extending to the pipe crown. In sewers with closely spaced manholes, the overall system capacity may suffer marked energy losses. These may be compensated for by providing additional drops in the pipe invert. Such modifications are particularly important for surcharged sewer systems in which flow velocities and the corresponding junction energy losses may become appreciable. The energy loss coefficients presented in this report can provide data useful in the computerized calculation of pressurized flow.
W86-00103

HYDRAULICS FOR OPERATORS,

Michigan Dept. of Public Health, Lansing. Section of Water Supply.
W. E. Brown.
Water Treatment Plant Operations Series, Volume 3, Ann Arbor Science, Ann Arbor, MI. 1981. Edited by V. W. Langworthy. 145 p.

Descriptors: *Hydraulics, *Hydrodynamics, *Flow characteristics, *Fluid mechanics, Orifices, Pipe flow, Channel flow, Flow measurement, Weirs, Manometers, Pumps, Pumping, Reviews.

This text is designed for trainees and personnel involved in water utility operations. Twelve lessons are presented on the flow of water and wastewater through pipes and channels, the use of pumps, and the effects of pressure exerted by water in a constructive or destructive fashion. Subject matter is presented in the simplest manner possible, and each lesson terminates with a list of problems and solutions for commonly encountered calculations or situations in the water utility field. The lessons presented are: hydraulic concepts, pressure, fundamentals of flow, pipe flow with friction loss, compound pipes, minor losses in fluid flow, flow in open channels, flow measurements, pump types and characteristics, and pumping. Lessons on the fundamentals of flow deal with head flow and Bernoulli's equation. Lessons on flow measurements deal with orifices, pipe flow, and Venturi meter, flow rate controls, manometers, weirs, other channel metering devices, and flow from the end of a pipe.
W86-00135

DIMENSIONS FOR SAFE AND EFFICIENT DEEP-DRAFT NAVIGATION CHANNELS: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
H. O. Turner.
Technical Report HL-84-10, December 1984. Final Report. 39 p, 27 Fig, 8 Ref.

Descriptors: *Model studies, *Design criteria, *Channel improvement, *Channel morphology, *Channels, *Navigation, Models, Watercourses, Planning, Telemetry.

Existing criteria for the design of deep-draft channels were evaluated to determine if revisions could be made to channel dimensions. Free-running, remote-controlled model ships at a scale of 1:100 were used to examine deep-draft navigation channel design methods. The tanker class of ships was used in the testing program because of the wide beam and slow response to rudder commands. The model ships were equipped with a video camera and telemetry instrumentation. Performance data concerning rudder angle, shaft rpm, and heading were also recorded and plotted. The straight reach tests were conducted at a depth to draft ratio of 1.2. The channel width dimension was narrowed until an unsafe condition existed. Results of model test for both one-way and two-way traffic showed that only a slight reduction in channel widths (about 10%) could be made. Additional safety factors should be allowed; however, revisions of the design criteria should not be based on the results of this study due to model scale effects and inaccuracies in the facility.
W86-00148

WEIR JETTY PERFORMANCE: HYDRAULIC AND SEDIMENTARY CONSIDERATIONS, HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W86-00152

BARCELONA HARBOR, NEW YORK, DESIGN FOR HARBOR IMPROVEMENTS: HYDRAULIC MODEL INVESTIGATION,

Coastal Engineering Research Center, Vicksburg, MS.
For primary bibliographic entry see Field 8A.
W86-00157

COMPUTER MODELING OF HYDRODYNAMICS AND SOLUTE TRANSPORT IN CANALS AND MARINAS: LITERATURE REVIEW AND GUIDELINES FOR FUTURE DEVELOPMENT,

National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5B.
W86-00179

CLEVELAND HARBOR, OHIO: DESIGN FOR THE SAFE AND EFFICIENT PASSAGE OF 1,000-FT-LONG VESSELS AT THE WEST (MAIN) ENTRANCE, HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W86-00204

MEGEE CREEK PUMPING STATION SIPHON, PIKE COUNTY, ILLINOIS: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Technical Report HL-82-23, September 1982. Final Report. 73 p, 17 Fig, 6 Tab, 6 Photos, 25 Plates, 15 Ref.

Descriptors: *Hydraulic structures, *Siphons, *Flood control, *Pumping plants, MeGee Creek Pumping Station, Hydraulic models, Model studies, Saxophone siphon, Outlets, Hydraulic jump.

A 1:4.36-scale hydraulic model of the proposed McGee Creek pumping station siphon was used to develop a design with adequate hydraulic performance. The saxophone outlet design was modified to ensure maintenance of the priming seal. Priming times and head losses were measured in the model. Modifications to decrease priming times were tested, including a reduced cross-sectional area at the crown, and air escape vents. The recommended design siphon operated satisfactorily for the entire range of expected tailwaters and discharges. (Author)
W86-00219

CHANNEL WIDTHS IN BENDS AND STRAIGHT REACHES BETWEEN BENDS FOR PUSH TOWING: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
L. J. Shows, and J. J. Franco.
Technical Report HL-82-25, October 1982. Final Report. 38 p, 9 Fig, 4 Photos, 7 Plates.

Descriptors: *Hydraulic structures, *Transportation, *Waterways, *Channel morphology, Navigable waters, Towing, Hydraulic models, Model studies, Shallow water, Ships.

This investigation was concerned with the development of parameters that could be used as a guide in the layout and design of shallow-draft waterways, particularly bends and straight reaches between bends. Results are based largely on model studies using different linear scales and some limited prototype tests. In negotiating a bend or making a turn, tows occupy a greater channel width than in straight reaches. The width of channel required depends on the deflection or drift angle which varies with the size of tow, radius of the bend or turn, length of the bend up to about 90 degrees, alignment and velocity of currents, weather conditions, direction of travel (upstream or downstream), draft of tow with respect to channel depth, alignment and location of the tow when entering the bend, and maneuverability of the tow. If the deflection angle assumed by a tow in negotiating a bend is known, the width of channel required can be computed using one of the equations from this study. Results include curves showing the deflection angle assumed by tows of various sizes in bends of different curvatures with and without currents. Also covered are bends consisting of compound curves, bends with irregular band lines, and lengths of straight reaches required between alternate bends. (Author)
W86-00225

MISSION BAY HARBOR, CALIFORNIA, DESIGN FOR WAVE AND SURGE PROTECTION AND FLOOD CONTROL: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
C. R. Curren.
Technical Report HL-83-17, June 1983. Final Report. 314 p, 12 Fig, 28 Tab, 100 Photos, 72 Plates, 23 Ref, 3 Append.

Descriptors: *Hydraulic structures, *Waves, *Shore protection, *Flood control, *Breakwaters, Tides, Hydraulic models, Model studies, Mission Bay Harbor, San Diego River, California, Harbors, Navigation, Shoals, Jetties, Surges, Water currents, Channels, Wave height.

A 1:100-scale hydraulic model of the Mission Bay Harbor, California, area was used to study proposed structures for improving navigation conditions at the harbor entrance, reducing surges inside the harbor, and eliminating potential flood hazards from a sand plug in the San Diego River flood control channel. Two alternatives were found viable for protecting the harbor from waves and surges. Both involved an offshore 1600-ft breakwater. Tests of the present configuration in the channel showed that upstream flooding occurred at 97,000 cfs, the maximum flood flow, as well as at 49,000 cfs. Several alternatives reduced flooding: reducing the elevation of the sand plug by 6 ft, dredging sections of the sand plug, building a weir into the middle jetty. To prevent formation of the sand plug several methods were also effective: extension of the south jetty, construction of a pilot channel in the sand plug, and a diversion structure on the middle jetty.
W86-00255

EDGEWATER MARINA, CLEVELAND, OHIO: DESIGN FOR WAVE PROTECTION, HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Bottin, and H. F. Acuff.
Technical Report Hl-83-11, July 1983. Final Report. 79 p, 6 Fig, 6 Tab, 28 Photos, 14 Plates, 11 Ref, Append.

Descriptors: *Hydraulic structures, *Shore protection, *Harbors, *Lakes, Breakwaters, *Waves, Navigation, Storms, Marinas, Cleveland Harbor, Edgewater Marina, Lake Erie, Hydraulic models, Model studies, Lake shores, Protection, Water currents, Wave height.

A 1:100-scale model was used to evaluate planned improvements at Edgewater Marina, Cleveland Harbor, Lake Erie. These improvements were 23 combinations of the following: modifications to the harbor entrance and channel, installation of new breakwaters, modifications to the existing structures, and installation of rubble absorbers in the harbor. Several optimal improvement plans were chosen, and of which should reduce or eliminate hazardous wave-induced currents in the basin during boating season. Optimal plans were chosen

for the following scenarios: (1) new breakwater installed at the entrance and the east breakwater raised to 9.5 ft, (2) absorber installed at the entrance and east breakwater raised to 9.5 ft, (3) existing entrance closed and raised to 9.5 ft, east breakwater raised to 9.5 ft, and new entrance through the west breakwater, and (4) curved portion of the Edgewater breakwater replaced with randomly placed stone and east breakwater raised to 15 ft.
W86-00256

DESIGN FOR PREVENTION OF BEACH EROSION AT PRESQUE ISLE BEACHES, ERIE, PENNSYLVANIA: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. C. Seabergh.
Technical Report HL-83-15, June 1983. Final Report. 315 p, 24 Fig, 4 Tab, 194 Plates, 10 Ref.

Descriptors: *Hydraulic structures, *Beaches, *Breakwaters, *Lakes, *Shore protection, Sediment transport, Wave action, Water currents, Groins, Model studies, Hydraulic models, Erosion control, lake shores, Presque Isle, Lake Erie.

Beach erosion at Presque Isle on Lake Erie was studied with a 1:50-scale hydraulic model. Various offshore breakwater plans were tested. Satisfactory results were obtained with 150-ft-long breakwaters with 350-ft spacing, regardless of groin presence or conformation. Tombolo development was dependent on proximity to groins, water level, wave height and period, crown elevation of the structure, distance of the breakwater from the initial shoreline, and sediment supply. Once a tombolo had attached to the breakwater, high water levels and waves overtopping the breakwater were required to erode the tombolo beachline back from the offshore breakwater. The strong longshore currents seen in the baseline tests were replaced by slower eddy-type currents behing the breakwaters. In large wave situations, currents moving lakeward between the breakwaters were diffused. Most sediment was retained shoreward of the line formed by the offshore breakwaters.
W86-00257

FUNCTIONAL DESIGN OF CONTROL STRUCTURES FOR OREGON INLET, NORTH CAROLINA: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
N. W. Hollyfield, J. W. McCoy, and W. C. Seabergh.
Technical Report HL-83-10, June 1983. Final Report. 458 p, 25 Fig, 11 Tab, 15 Photos, 365 Plates, 4 Ref.

Descriptors: *Hydraulic structures, *Breakwaters, *Channels, *Tidal effects, Manteo Bay Project, Oregon Inlet, North Carolina, Hydraulic models, Model studies, Jetties, Inlets, Waterways, Shoals, Navigation.

Control of shoaling and breaking waves in Oregon Inlet in North Carolina's Outer Banks was investigated by model testing. The model for the Manteo Bay Project had a 1:300 horizontal and 1:60 vertical scale. Testing included the study of jetty alignment, length, and spacing and the effects of jetty structures on tidal exchange and on the flow through Bonner Bridge. Steady-state ebb and flood storm surges were reproduced to study the effects of the jetties on these flows. Staged jetty construction tests helped to determine the best construction sequence to limit excessive scour velocities. Movable bed tests provided information on the effects of jetties on channel alignment for both normal tides and during storm surge conditions. A parallel two-jetty arrangement would not negatively impact the tidal exchange, storm surge flows, or flow through Bonner Bridge over the inlet. Spacings of 2500, 3500, and 5000 ft were all suitable. However, the large spacings may permit bifurcation of the entrance channel or a more curvilinear channel.
W86-00269

WAVE DATA ACQUISITION AND HINDCAST FOR SAGINAW BAY, MICHIGAN,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2H.
W86-00282

BLOOMINGTON SPILLWAY NORTH BRANCH POTOMAC RIVER MARYLAND AND WEST VIRGINIA: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
B. P. Fletcher.
Technical Report HL-83-9, June 1983. Final Report. 68 p, 11 Fig, 1 Tab, 8 Photos, 30 Plates.

Descriptors: *Hydraulic structures, *Spillways, *Dams, *Model studies, Hydraulic models, Bloomington Spillway, Potomac River, Gates, Dikes, Tainter gates, Eddies, Water currents, Flow pattern, Overburden, West Virginia, Maryland.

Tests to investigate hydraulic performance of the gated spillway and the intensity of return flow on the downstream side of the saddle dike were conducted using a 1:60-scale model. Flow approaching the spillway was satisfactory for all anticipated flow conditions. Eddies generated immediately upstream from the spillway had no significant effect on hydraulic performance. During controlled releases, no surging of flow at the abutments or tainter gates was observed. Model tests of the exit area were conducted with the overburden fixed and then movable. Tests conducted with the fixed overburden indicated that the maximum spillway flow of 178,000 cfs generated only an insignificant (4-ft depth at toe) amount of return flow toward the downstream toe of the saddle dike. Tests conducted with the movable overburden indicated significant displacement caused by a spillway flow of 10,000 cfs. Flows as great as 178,000 cfs caused additional displacement of overburden. The overburden did not scour upstream to the toe of the dike. Test results indicated that the safety of the saddle dike was not jeopardized by return flow with either the fixed or movable overburden simulated in the model. For any spillway flow condition, overburden material downstream from the spillway was transported through the swale and there was no tendency for a debris dam to form. (Author)
W86-00285

GRAYS LANDING SPILLWAY AND STILLING BASIN, MONONGAHELA RIVER, PENNSYLVANIA: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
E. D. Rothwell, N. R. Oswalt, and S. T. Maynord.
Technical Report HL-81-13, November 1981. Final Report. 78 p, 6 Fig, 8 Tab, 32 Photos, 12 Plates.

Descriptors: *Hydraulics, *Spillways, Stilling basins, *Reservoirs, *Dams, Hydraulic models, Model studies, Grays Landing Spillway, Monongahela River, Pennsylvania, Ice, Baffles, Design criteria, Energy dissipation, Locks, Riprap.

The hydraulic performance of the deeply submerged stilling basin for the Grays Landing spillway was studied on a 1:36-scale section model. The best design was a conventional hydraulic jump type energy dissipator which would perform well for both initial construction of one lock, a 576-ft-wide spillway crest and stilling basin, and the ultimate construction of two locks, a 460-ft-wide spillway crest and stilling basin. This design allowed the baffle blocks to be located farther downstream to prevent the ice from attecking the baffles and stilling basin apron. The recommended downstream riprap protection consisted of a 72-ft length of 30-inch riprap with a maximum stone weight of 1350 pounds, followed by a 108-ft length of 18-inch riprap with a maximum stone weight of 292 pounds.
W86-00304

8C. Hydraulic Machinery

POINTE COUPEE PUMPING STATION SUMP AND OUTLET STRUCTURE, UPPER POINTE COUPEE LOOP AREA, LOUISIANA: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Technical Report HL-83-3, March 1983. Final Report. 103 p, 20 Fig, 32 Tab, 18 photos, 8 plates.

Descriptors: *Models, *Model studies, *Pumps, *Hydraulic models, *Hydraulic equipment, *Design criteria, *Sumps, *Stilling basins, Hydraulic machinery, Performance evaluation, Pumping plants.

Physical models were used to arrive upon a design that would afford optimum hydraulic performance of the Pointe Coupee pumping station sump and outlet structure. A sump design with umbrellas on the suction bells, converging sidewalls, and horizontal vortex supressor beams gave satisfactory sump performance for pumps with low submergence. The umbrellas significantly reduced surface vortices and pressure fluctuations by spreading the flow entering the suction bell. Converging sidewalls streamlined the flow lines entering the suction bell, thus reducing the swirl and the tendency to form surface vortices. The best location for the vortex suppressor beams was just above the upstream lip of the umbrella. Beams should extend approximately 1 ft into the flow and be about 1 ft apart. A hydraulic jump type stilling basin with baffles and divider walls was also developed. Riprap sizes were determined for the outlet channel downstream from the stilling basin. With these modifications, satisfactory sump performance was obtained even for the adverse approach conditions that occur with single pump operations.
W86-00101

MEGEE CREEK PUMPING STATION SIPHON, PIKE COUNTY, ILLINOIS: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00219

FLATIRON AGC INTERIM CONTROLLER-VOLUME IV,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
W. B. Gish, T. R. Whittemore, C. A. Lennon, and S. C. Stitt.
REC-ERC-84-6, March 1984. 167 p, 165 Fig, 2 Ref.

Descriptors: *Hydraulic machinery, *Electrical equipment, *Computers, *Control systems, *Automation, Flatiron Automatic Generation Controller, Controllers, Laramie River Power Station, Mt. Elbert Powerplant.

The Flatiron Interim Automatic Generation Controller has been placed in service for the Lower Missouri Western Area Power Administration Control Area. This controller controls the energy generation and transfers in northern Colorado, Wyoming, western Nebraska, western South Dakota, and southern Montana. The four-volume series details the design, construction, maintenance and operation of the master station and the remote stations. This volume contains all the hardware and software drawings for the first three volumes in the series, which document the master station system at the Dispatch Center, the Laramie River Power Station RTU, and at Mt. Elbert Powerplant RTU.
W86-00223

BARKLEY DAM SPILLWAY TAINTER GATE AND EMERGENCY BULKHEADS, CUMBERLAND RIVER, KENTUCKY: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station,

Vicksburg, MS. Hydraulics Lab.
J. E. Hite, and G. A. Pickering.
Technical Report HL-83-12, August 1983. Final Technical Report HL-83-12, August 1983. Final
Report. 77 p, 9 Fig, 8 Tab, 12 Photos, 29 Plates.

Descriptors: *Hydraulic structures, *Dams, *Gates, *Spillways, Tainter gates, Spillway gates, Barkley Dam, Cumberland River, Kentucky, Locks, Navigation, Reservoirs, Model studies, Flow pattern, Stilling basins, Piers, Bulkhead gates.

Tests were conducted on 1:15- and 1:50-scale models to determine the cause of and to make modifications for eliminating tainter gate bouncing experienced under certain flow conditions at Barkley Dam. The 1:15-scale model determined the flow conditions that caused the bouncing, and the hydraulic loads and load variations acting on the gate during this occurrence. Hoist load fluctuations in excess of 140 kips were measured. The bottom of the tainter gate was modified to various configurations in an effort to alter the flow patterns causing the bouncing, but these modifications were relatively ineffective in reducing the hoist loads. A 1:50-scale model was incorporated into the study to determine the effect of the downstream spillway piers and the stilling basin on the flow conditions. Test results indicated that increasing the length of the spillway piers by 20 ft downstream reduced the surging of flow associated with the bouncing. A minimum top elevation of these extended piers was determined to be 345.0. The hoist loads were then measured with the piers placed in the 1:15-scale model. The maximum hoist load fluctuation was reduced by over 100 kips from 140 kips with the original design to 40 kips with the piers extended. The 1:15-scale model was also used to determine the hydraulic loads that occur as the emergency bulkheads are lowered under flowing water conditions. The bulkhead tests revealed that the loads on the hoist due to hydraulic forces were not extreme for heads on the gate still of 21, 29, and 34 ft as long as the bulkhead was lowered at the prototype hoisting speed of 4 to 6 ft/min. Unstable loads were encountered at heads of 29 and 34 ft on the gate sill when the bulkhead was held at stationary position above the crest with high tailwater conditions. (Author)
W86-00284

8D. Soil Mechanics

PROGRAM CRITERIA SPECIFICATIONS DOCUMENT: COMPUTER PROGRAM TWDA FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS,
Army Engineer Div. Lower Mississippi Valley, Vicksburg, MS.
For primary bibliographic entry see Field 8A.
W86-00193

CHANNEL CONTROL STRUCTURES FOR SOURIS RIVER, MINOT, NORTH DAKOTA: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W86-00209

LIST OF SOILS, SOIL-STRUCTURE INTERACTION AND OTHER RELATED COMPUTER PROGRAMS AVAILABLE FOR LMVD ENGINEERS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing Center.
N. Radhakrishnana, and P. K. Senter.
Technical Report K-81-1, May 1981. Final Report. 146 p.

Descriptors: *Soil mechanics, *Computer programs, *Hydraulic structures, *Earthworks, T-walls, Slope stability, Retaining walls, Piles, Seepage, Stress, Structural settlement, Piezometers, Measuring instruments, Surveying instruments, Data processing, Plotting, Finite difference methods, Earthquakes, Mississippi River Valley.

This report presents a list of soils, soil-structure interaction, and other related computer programs available for engineers of the Lower Mississippi Valley Division. Programs for use in the following subject areas are listed: T-walls; slope stability; piles, sheet piles, and cells; seepage; stress computation, settlement, and consolidation; piezometer data; instrumentation and laboratory data; plotting programs; finite element and finite difference methods; earthquakes and dynamics; and others. Also included are abstracts of some of the listed programs. (Author)
W86-00262

WAVE STABILITY STUDY OF RIPRAP-FILLED CELLS: HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8A.
W86-00283

8E. Rock Mechanics and Geology

SAND RESOURCES AND GEOLOGICAL CHARACTER OF LONG ISLAND SOUND,
Coastal Engineering Research Center, Fort Belvoir, VA.
S. J. Williams.
Technical Paper No. 81-3, May 1981. 65 p, 27 Fig, 5 Tab, 54 Ref, 2 Append. Project No. D31665.

Descriptors: *Shoals, *Beaches, *Shore protection, *Sediments, Marine sediments, Sand, Gravel, Long Island Sound, Connecticut, Dredging, Bottom sediments, Geology, Marine geology, Continental shelf, Erosion.

Seismic profiles and vibratory cores were used to determine the geologic character of Long Island Sound. Fourteen isolated shoal features were identified as potential sources of beach fill sand and construction aggregate. About 189 million cu m of sand and gravel was estimated to be in water depths not exceeding 20 meters. Fifteen Connecticut beaches needing beach nourishment now and in the future were identified. Many parks and beaches on Long Island's north shore also may benefit from beach fill.
W86-00205

8F. Concrete

ENGINEERING CONDITION SURVEY OF CONCRETE IN SERVICE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
R. L. Stowe, and H. T. Thornton.
Technical Report REMR-CS-1, September 1984. Final Report. 109 p, 33 Fig, 69 Ref, 1 Append.

Descriptors: *Concrete technology, *Surveys, *Concrete testing, Evaluation, Structural engineering, Materials testing, Safety, Standards, Concrete construction, Rehabilitation.

Civil works structures must be continually evaluated for structural safety, stability, and operational adequacy. The overall objective of the investigation documented in this report is to develop information essential to the continued safety of concrete used in civil works structures such as flood control and multipurpose dams, navigation locks and dams, powerhouses and appurtenant structures, floodwalls, pumping stations, and similar structures. Specific objectives include (a) the development and evaluation of materials and techniques for repair and rehabilitation of civil works structures, (b) the development of engineering guidance to evaluate and monitor safety of structures, and (c) the development of design and construction methods for rehabilitating older structures to comply with current structural design criteria. A condition survey of a civil works structure includes a comprehensive review of the design of the structure, construction techniques and materials, and operational maintenance history. Information is obtained from available engineering data on the structure as well as on-site investigations. Data are analyzed and an evaluation report is written which includes conclusions and/or repair recommendations. This report summarizes pertinent inspection procedures and methods of evaluation used by the Corps of Engineers in evaluating concrete civil works structures. Methods of evaluation include experience gained at the Waterways Experiment Station. Techniques are presented which have a potential for ascertaining the extent and cause of inadequacies in concrete structures. (Author)
W86-00161

8G. Materials

SHORE STABILIZATION WITH SALT MARSH VEGETATION,
Coastal Engineering Research Center, Fort Belvoir, VA.
P. L. Knutson, and W. W. Woodhouse.
Special Report No. 9, January 1983. 95 p, 38 Fig, 4 Tab, 94 Ref. Project No. D31234.

Descriptors: *Erosion control, *Estuaries, *Shore protection, *Marshes, *Vegetation, Fertilizers, Salt marshes, Wetland, Waves, Soil types, Sediments, Salinity, Particle size, Tidal marshes, Wind waves, Cordgrass, Spartina, Sedges, Rushes, Reeds, Mangrove, Environmental effects, Hairgrass.

Comprehensive guidelines are given on the use of marsh plants to control shore erosion from wind waves and tidal currents. Background information includes the role of marsh plants in erosion control, description of the natural coastal marshes by region, and the concept of encouraging marsh establishment to control shore erosion. Planting success depends on several factors. Soil type (cohesive or sandy) often dictates the choice of planting and fertilizer requirements. Some plants tolerate salinity up to the strength of sea water. Most marsh plants are adapted to anaerobic conditions. Exposure to direct sunlight must be assured by clearing woody vegetation 3-5 meters landward. The minimum planting width is about 6 meters. Sediment is beneficial to plantings. An evaluation form for evaluating a site for potential planting success uses shore characterisitics (average and longest fetch, shoreline geometry, and sediment grain size). Smooth cordgrass (Spartina alterniflora) is suggested for the Atlantic and Gulf coasts; Pacific cordgrass (Spartina foliosa) for the southern Pacific coast; and Lyngbye's sedge (Carex lyngbyei) and tufted hairgrass (Deschampsia aespitosa) for the northern Pacific coast. Plant materials, available as sprigs, pot-grown seedlings, and plugs, can be planted by hand, power-driven auger, or machine. Fertilizers and application rates are given. Detailed planting specifications are described for a variety of plant species. Cost comparisons of erosion control methods and the potential benefits and disadvantages are summarized.
W86-00189

MODIFICATION OF BELL CANYON TEST (BCT) 1-FF GROUT,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
A. D. Buck, J. E. Rhoderick, J. P. Burkes, K. Mather, and R. E. Reinhold.
Miscellaneous Paper SL-83-18, Report No. SAND 83-7097, September 1983. Final Report. 53 p, 24 Fig, 7 Tab, 6 Ref, 2 Append.

Descriptors: *Water quality control, *Grouting, *Water pollution prevention, *Radioactive waste disposal, Waste disposal, Cements, Bell Canyon, Boreholes, Fly ash, Silica fume, Physical properties, Chemical properties.

Bell Canyon Test (BCT) 1-FF grout was developed as a candidate material for use in repository sealing applications and was actually used in two field tests in New Mexico. This grout and modifications of it were made in the laboratory and tested or examined for workability, compressive strength, restrained expansion, permeability, phase composition, and microstructure. Most of these were done to an age of one year. Compressive

strength and expansion data were determined beyond this age (960 days). Modifications included use of three other cements, two other fly ashes, a silica fume, different water contents, and different amounts of expansive additive (plaster). Each cement and mineral admixture was characterized by conventional chemical and physical tests as well as by X-ray diffraction examination. In general, the results indicated that the modifications to the basic BCT-1-FF grout produced other grouts that were as good as it. An exception to this was the grout mixture (M-8-C) made with shrinkage compensating expansive cement; it had an excessive flow time (> 20 sec). Another grout mixture (M-9-C) also had excessive flowtime and lower strength. It was thought that these problems could be solved with more modification to these two mixtures. (Author)
W86-00248

PREVENTATIVE MEASURES TO LIMIT STRESS CORROSION CRACKING IN PRESTRESSED CONCRETE,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
E. F. O'Neil.
Miscellaneous Paper SL-83-14, September 1983. Final Report. 15 p, 4 Fig, 8 Ref.

Descriptors: *Hydraulic structure, *Corrosion control, *Construction materials, *Concrete, *Steel, Coatings, Wires, Polymers, Stress, Cement, Metals, Grouting, Aggregates.

Preventive measures to minimize stress corrosion cracking of prestressed steel are reviewed. Although the mechanisms causing this type of corrosion are little understood, several actions are helpful. Steel properties may be modified to reduce the tendency to corrode. Techniques to improve stress corrosion cracking are proper stress relieving of cold-drawn wire, new methods of quenching and tempering, decarbonizing the surface of the steel, shot peening, and lower final stress levels. Any method that can exclude corrosive gases and liquids also minimizes stress corrosion cracking. Factors in this category are a dense, low-permeability concrete (proper water-cement ratio), good concrete workability, coarse aggregate material, proper vibration in compacting concrete, and longer cure time for concrete. Grouted prestressing systems can be designed with a suitable conduit and grout composition and application. Other methods of protecting steel wires are galvanization, plastic coatings, and polymer impregnated in the pore structure of the concrete.
W86-00249

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

IMPACT OF WATER LEVEL CHANGES ON WOODY RIPARIAN AND WETLAND COMMUNITIES; VOLUME X: INDEX AND ADDENDUM TO VOLUMES I-VIII,
Washington Univ., Seattle. Coll. of Forest Resources.
For primary bibliographic entry see Field 2I.
W86-00254

ANNOTATED BIBLIOGRAPHY ON NORTHERN ENVIRONMENTAL ENGINEERING, 1978-1979,
Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
B. C. Armstrong.
EPS 3-WP-81-4, July 1981. 100 p.

Descriptors: *Bibliographies, *Wastewater treatment, *Water treatment, *Cold regions, *Arctic, *Environmental engineering, Polar regions, Ice, Dams, Construction, Industrial wastes, Water pollution.

An annotated bibliography on environmental engineering in northern regions is presented with key words and alphabetical subject index. This biennial edition covers the literature from 1978 and 1979. Among the many subjects are wastewater collection and treatment, construction, dams, water treatment and distribution, environmental impact studies, freeze protection, ice growth, industrial wastes, soils, underground utilities, water pollution, and water supply.
W86-00289

10F. Preparation Of Reviews

MICROBIOLOGICAL WATER QUALITY OF IMPOUNDMENTS: A LITERATURE REVIEW,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
For primary bibliographic entry see Field 5A.
W86-00185

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VOLUME 19, NUMBER 2
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SELECTED
WATER RESOURCES ABSTRACTS

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VOLUME 19, NUMBER 2
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W86-00308 -- W86-00613

The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

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PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
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MS 425 National Center
Reston, VA 22092

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03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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2. WATER CYCLE

2A. General

SUMMARY OF CLIMATIC CONDITIONS IN NATAL.

Cedara Research Inst., Pietermaritzburg (South Africa).
Report N2/1982, January 1982. 60 p.

Descriptors: *Meteorologic data collections, *Climatic data, *Precipitation, *Temperature, *Evaporation, Standard deviation, Natal, South Africa, Wind velocity, Rainfall, Elevation, Solar radiation, Air temperature.

Tables show the climatic conditions in Natal, South Africa. Seven climatic elements for about 60 stations are included: maximum temperature, minimum temperature, average temperature, average rainfall, average evaporation, average wind velocity, and average sunshine. The importance of standard deviation is emphasized.
W86-00321

RETURN PERIOD ANALYSIS WITH SLIDING POLYNOMIALS,

Southern Piedmont Conservation Research Center, Watkinsville, GA.
W. M. Snyder, and A. W. Thomas.
Presented at the 1983 Winter Meeting of the American Society of Agricultural Engineers, Paper No. 83-4533, December 13-16, 1983, Chicago, IL. 7 Fig, 3 Tab, 10 Ref.

Descriptors: *Sliding polynomials, *Graphical methods, *Probability distributions, *Mathematical studies, *Statistical methods, *Mathematical models, Comparison studies, *Return flow, Models, Mathematical equations, Computer models, Statistical models, Statistical analysis, Model studies, Prediction, *Flood forecasting, Graphical analysis.

A method of return-period analysis is presented which does not require assumption of a probability function or of plotting positions. Piece-wise sliding polynomials are used to smooth historical samples by least squares. Imposition of a boundary control produces a restrained fitting which suppresses much sample-to-sample variability for extreme values. Variability of predictions for the 1-in-100 event is only one-fifth the variability using the graphical method. The method can be used to estimate uncertainty of prediction for any chosen level of risk. (Author's abstract)
W86-00374

RETURN PERIOD ANALYSIS OF MINIMUM EVENTS USING SLIDING POLYNOMIALS,

Southern Piedmont Conservation Research Center, Watkinsville, GA.
A. W. Thomas, and W. M. Snyder.
Presented at the 1983 Winter Meeting of the American Society of Agricultural Engineers, Paper No. 83-4534, December 13-16, 1983, Chicago, IL. 15 p. 7 Fig, 9 Ref.

Descriptors: *Model studies, *Simulation analysis, *Stochastic process, *Sliding polynomials, *Mathematical studies, *Mathematical models, *Probability distribution, Models, Probabilistic process, Planning, Temperature, Rainfall, Statistical methods, Streamflow, *Return period.

A form-free method for determining return periods of minimum values of stochastic events has been developed. Such minima represent expectancies of limited availability of natural resources and their analyses can aid planners and managers of agricultural production systems. The method for return-period analysis of minimum events, like that for maximum events, used form-free sliding polynomials as smoothing operators, thus reducing the bias produced by assuming some particular probability function as a smoothing operator. Studies of minimum rainfall, streamflow and temperatures showed flexibility in shaping the smoothing curves while maintaining faithful adherence to the sample data. Simulations were used to compute and expected range of future events associated with any level of risk selected by the user. Simulations of long-period and short-period possible future minima for different return periods showed that the uncertainties faced by planners and managers are highly conditioned by unique features of particular data sets and by the length of the return period over which costs and benefits might be averaged.
W86-00375

TESTING THE CLIMATIC REPRESENTATIVENESS OF SHORT-PERIOD RECORDS THROUGH SIMULATION,

Southern Piedmont Conservation Research Center, Watkinsville, GA.
A. W. Thomas, and W. M. Snyder.
To be presented at: the 1984 Winter Meeting of the American Society of Agricultural Engineers, Paper No. 84-2501, December 11-14, 1984, New Orleans, LA., 16 p. 7 Fig, 3 Tab, 6 Ref.

Descriptors: *Mathematical models, *Model studies, *Rainfall, *Stochastic process, *Sliding polynomials, *Probabilistic process, *Statistical models, *Climatology, Models, Mathematical studies, Planning, Probability distribution, Statistical methods, Statistical analysis, Simulation analysis.

A form-free method was devised and tested for evaluating the climatic representativeness of short-period records. The method is similar to recently developed stochastic analyses of maximum and minimum events in that sample probabilities are least-squares derivation of arcs of the four-point sliding polynomials. Both large and small events were analyzed as well as averages or totals. In addition, a procedure was devised to handle the occurrences of numerous days with no rainfall with an adaptation of the virtual and real approach based on smoothing with sliding polynomials. The stochastic characteristics of long term rainfall record established a probabilistic scale against which to test events during short-period research. This probability scale determined a standard from which judgemental assessment to representativeness can be made. Planners must consider the representativeness of data in order to assess agricultural practices and programs.
W86-00376

SOIL-PLANT-WATER MODEL WITH A CASE STUDY IN A FORESTED CATCHMENT,

Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
For primary bibliographic entry see Field 2I.
W86-00595

2B. Precipitation

COMBINED HYDROMETEOR DISTRIBUTIONS FROM THREE PMS PROBES,

Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W86-00308

TESTING THE CLIMATIC REPRESENTATIVENESS OF SHORT-PERIOD RECORDS THROUGH SIMULATION,

Southern Piedmont Conservation Research Center, Watkinsville, GA.
For primary bibliographic entry see Field 2A.
W86-00376

GROSSVERSUCH IV: 'EXTENDED AREA' EFFECTS ON RAINFALL,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Atmospheric Physics Lab.
For primary bibliographic entry see Field 3B.
W86-00424

OBSERVATION ON MICROPHYSICAL PROCESSES IN THE STRATIFORM PRECIPITATIONS INCLUDING MELTING LAYERS AT MT. FUJI,

Nagoya Univ. (Japan). Water Research Inst.
T. Yokoyama, H. Tanaka, K. Akaeda, T. Ohtani, and N. Yoshizawa.
Journal of the Meteorological Society of Japan, Vol. 63, No. 1, p 100-111, February, 1985. 9 Fig, 1 Tab, 18 Ref.

Descriptors: *Mt. Fuji, *Japan, *Precipitation, *Snow, *Rain, Stratiform, Micrometeorology.

In order to investigate microphysical processes in stratiform precipitations including melting layers, size distributions of the precipitation particles were measured by filter paper methods at three observational stations with different altitude on Mt. Fuji, Japan. Where snowflakes form, above or at the upper edge of the melting layer, small sized particles smaller than 0.1 cm in diameter were predominant in number and volume. Where snowflakes melt and refreeze, forming sleet, and in the melting layer, large sized particles larger than 0.2 cm increase in number and predominate in volume. Small sized particles decrease. Where raindrops form, below the melting layer, medium sized particles between 0.1 and 0.2 cm predominate in volume. The vertical change of the size distribution of raindrops was insignificant far below the melting layer. (Baker-IVI)
W86-00425

EXPERIMENTS ON AEROSOL SCAVENGING BY NATURAL SNOW CRYSTALS, PART I: COLLECTION EFFICIENCY OF UNCHARGED SNOW CRYSTALS FOR MICRON AND SUBMICRON PARTICLES,

Hokkaido Univ., Sapporo (Japan). Div. of Environmental Structure.
M. Murakami, K. Kikuchi, and C. Magono.
Journal of the Meteorological Society of Japan, Vol. 63, No. 1, p 119-129, February, 1985. 11 Fig, 17 Ref.

Descriptors: *Aerosols, *Snow, *Precipitation, Micrometeorology, Clouds, Crystals, Collection efficiency.

In order to verify the collection efficiencies which were observed in earlier studies and to investigate some effects on the collection efficiency, experiments on the collection of aerosol particles (0.1 micro-m < dp < 6 micro-m) by uncharged natural snow crystals were carried out in an aerosol chamber. The collection efficiency of the uncharged snow crystals decreased with the decreasing aerosol size from 6 micro-m to 0.2 micro-m in diameter. The collect efficiency attained the minimum value at around 0.2 micro-m, and increased with the decreasing aerosol size from 0.2 micro-m to 0.1 micro-m. As for the aerosol particles of 0.2 micro-m to 6 micro-m in diameter, it was deduced that the interception was the main scavenging mechanism. The difference between the collection efficiencies of the rimed and unrimed snow crystals was small in the present experiments. This means that the aerodynamic effects were small. The difference of one order of magnitude between the collection efficiencies of the rimed and unrimed snow crystals, obtained in earlier studies, was attributed to the in cloud scavenging effect. The collection efficiency obtained in the present experiments was almost coincident with that of the unrimed snow crystals obtained from previous field observations. The observational values of particle averaged collection efficiency previously obtained were verified by the collection efficiency, which was given as a function of particle size, obtained in the present studies. (Baker-IVI)
W86-00426

BUDGET OF NITROGEN DISSOLVED IN RAINFALL DURING ITS PASSING THROUGH THE CROWN CANOPY IN FOREST ECOSYSTEMS,

Polish Academy of Sciences, Lomianki. Inst. of Ecology.
A. Stachurski, and J. R. Zimka.
Ekologia Polska, Vol. 32, No. 2, p 191-218, 1984. 11 Fig, 7 Tab, 17 Ref.

Descriptors: *Throughfall, *Canopy, *Nitrogen, *Rainfall, *Forests, Fauna, Leaching, Aerosols, Ecosystems, Nutrients, Poland.

The effects of hydrologic and biotic factors on the budget of nitrogen in throughfall were investigated. A new type of rain trap with a double filter system was set up in open spaces and beneath the canopy. During the growing season nine forest ecosystems representing five physiosociological units were analyzed in the Kampinos National Park and in Masurian forests in Poland. The input of nitrogen in water solutions from the atmosphere ranged from 3.8 kg/ha/growing season to as much as 21.8 kg/ha/growing season. The rate of nitrogen input was also variable. The budget of dissolved nitrogen in the forest ecosystems was positive (Kampinos) or strongly negative (Masuria), but no consistent differences could be found related to a particular species structure of the stands. Using the multiple regression method, the effect was analyzed of four factors on the nitrogen budget discussed: amount of rainfall intercepted by the canopy, amount of water in the throughfall phytophage activity measured by biomass, and the quantity of nitrogen input with water solutions from the atmosphere. Phytophage activity caused an enrichment of the throughfall with nitrogen, while dissolved nitrogen input from the atmosphere was absorbed by the canopy layer. Nearly 80% of the nitrogen input from the atmosphere was absorbed by the canopy. The passing of nitrogen in water solutions through the canopy is not static in nature, nor is it controlled by hydrologic factors. It is a fully dynamic process controlled by biotic factors, and its final result is determined by the quantitative predominance of either factor, the effect of which is opposite to that of the other: nitrogen absorption by the canopy, and phytophage activity. (Baker-IVI)
W86-00437

SIMULATION OF CORRELATED RAINFALL AMOUNT AND DURATION DATA,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
K. B. Rojiani, K. A. Tarbell, V. O. Shanholtz, and F. E. Woeste.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 129-132, January/February, 1985. 5 Fig, 2 Tab, 6 Ref. OSM grant G1115514.

Descriptors: *Rainfall, *Simulation, Distribution, Duration, Least squares method.

Rainfall amount and storm duration are two important variables in the modeling and simulation of erosion loss and sediment yield. Because rainfall amount and storm duration are often correlated, a procedure for simulating this correlation is desirable. A technique is presented for generating compatible sets of rainfall amount and storm duration values. The method is based on regression analysis and requires a knowledge of the distribution of one of the individual variables and the correlation between the two variables, but not the joint probability distribution. Random values generated from the distribution of storm duration are used to predict the associated random values of the rainfall amount. Using a 28 year data base from Blacksburg, Virginia, distributions for rainfall amount and storm duration were obtained. Using the model, compatible values of rainfall amount and storm duration were generated using the regression model. A comparison of distribution form and distribution parameters for the original and simulated data indicated that the simulated data mimicked the original data. The technique provides a useful and practical method for generating correlated rainfall data. (Baker-IVI)
W86-00492

ESTIMATING SOIL DETACHMENT CAUSED BY RAINDROP IMPACT,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
J. E. Gilley, and S. C. Finkner.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 140-146, January/February, 1985. 2 Fig, 4 Tab, 22 Ref.

Descriptors: *Rain, *Impact, *Velocity, *Soil detachment, Kinetic energy, Mathematical equations, Soil erosion.

This study was an attempt to evaluate, using existing data, the performance of several soil detachment relations; identify a detachment equation for use with raindrops impacting at terminal velocity and determine the rainfall detachment factor as a function of rainfall itensity for natural rainfall conditions. The rainfall factors which were examined included: kinetic energy times unit of drop area, kinetic energy times unit of drop circumference, kinetic energy, kinetic energy per unit of drop circumference, kinetic energy per unit of drop area, momemtum times unit of drop area, momentum times unit of drop circumference, momentum, momentum per unit of drop circumference and momentum per unit of drop area. Dimensionless equations incorporating each of these parameters were derived. For the selected rainfall factors, the only difference between the dimensionless equations was found to exist in the exponent values to which the relative raindrop diameter and velocity variables were raised. Use of kinetic energy times unit of drop circumference for determining soil detachment for individual soils was also examined. The reliability of estimates obtained using this factor varied significantly between soil materials. For the case of raindrops falling at terminal velocity, impact velocity was written as a function of raindrop diameter and, therefore, eliminated in the detachment equation. From information available in the literature on the drop size distribution of natural rainfall at varying rainfall intersities, an equation relating soil detachment to rainfall intensity was obtained. (Baker-IVI)
W86-00494

DROP SIZE DISTRIBUTION MEASUREMENT PROBLEMS USING A LASER UNIT,

South Dakota State Univ., Brookings. Dept. of Plant Science.
For primary bibliographic entry see Field 7B.
W86-00502

2D. Evaporation and Transpiration

TABLES FOR ESTIMATING DAILY EVAPORATION RATES OVER CROPS USING TEMPERATURE, ELEVATIONAL AND LATITUDINAL DATA ONLY,

Cedara Research Inst., Pietermaritzburg (South Africa).
For primary bibliographic entry see Field 2I.
W86-00313

TRANSPIRATION EFFICIENCY IN RELATION TO NUTRIENT STATUS,

Guelph Univ. (Ontario). Dept. of Land Resource Science.
G. K. Walker, and J. E. Richards.
Agronomy Journal, Vol. 77, No. 2, p 263-269, March-April, 1984. 4 Fig, 3 Tab, 21 Ref.

Descriptors: *Alfalfa, *Corn, *Transpiration, *Nutrients, Potassium, Biomass, Water use, Evapotranspiration, Fertilizers.

Many experiments have shown a linear relationship between plant biomass and water use. Despite this, it is thought that general nutrient deficiency lowers transpiration efficiency. Since little attention has been given to the effects of specific nutrients, a study was designed to examine the effects of a single nutrient, K, on the transpiration efficiency of alfalfa (Medicago sativa L.). In addition, maize (Zea mays L.) biomass and water-use data obtained in 1911 by Montgomery and Kiesselbach, at a range of nutrient levels, were reanalyzed to further assess nutrient effects on transpiration efficiency. In a greenhouse study, 'Banner' alfalfa was grown, in pots, in a range of soils varying widely in K status but otherwise adequately fertilized. A sand mulch was used to minimize evaporation from the pots. Evapotranspiration (determined by weighing) and biomass data were collected over seven regrowth cycles. At every harvest there was a wide range in tissue K status, but only at harvest four did transpiration efficiency appear reduced by restricted K supply. Biomass and evapotranspiration remained well correlated and linearly related for every harvest, despite the increasing occurrence of severe K deficiency as the experiment progressed. Transpiration efficiency did fall substantially for the last two harvests, possibly in response to the lower (winter) light regime under which those harvests were made. Although not applicable to specific nutrient, Montgomery and Kiesselbach's maize data yield similar results, and do not suggest the nutrient deficiency leads to lower tramspiration efficiency. (Author's abstract)
W86-00464

RELATIONSHIPS BETWEEN CROP WATER STRESS INDEX AND ALFALFA YIELD AND EVAPOTRANSPIRATION,

New Mexico Agricultural Experiment Station, Las Cruces.
For primary bibliographic entry see Field 2I.
W86-00468

TIME SERIES ANALYSIS OF DAILY SOLAR RADIATION AND AIR TEMPERATURE MEASUREMENTS FOR USE IN COMPUTING POTENTIAL EVAPOTRANSPIRATION,

California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.
N. Persaud, and A. C. Chang.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 462-470, March/April, 1985. 7 Fig, 7 Tab, 10 Ref.

Descriptors: *Time series analysis, *Air temperature, *Evapotranspiration, *Solar radiation, Evaporation, Transpiration, Temperature effects.

Time series analysis techniques were used to study the bivariate relationships between daily maximum, minimum, or average air temperatures and solar radiation. The data utilized in the analysis consisted of 1096 daily observations of the four variables taken near Arvin in the San Joaquin Valley, California for the years 1959-1961. The annual cycle and the semi-annual cycle contributed the most to the variance of the temperature series. Spectral analysis in conjunction with Box-Jenkins transfer function techniques proved useful to estimate the daily solar radiation with daily temperature measurements as the input data. The potential evapotranspiration (PET) values computed from the estimated solar radiation data agreed well with those obtained from computation using measured daily solar radiation. (Baker-IVI)
W86-00469

EFFECT OF POTENTIAL EVAPOTRANSPIRATION ESTIMATES ON CROP MODEL SIMULATIONS,

Agricultural Research Service, Tempie, TX.
W. A. Dugas, and C. G. Ainsworth.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 471-475, March/April, 1985. 2 Fig, 2 Tab, 19 Ref.

Descriptors: *Evapotranspiration, *Mathematical equations, *Model studies, Crop yield, Wheat, Corn, Sorghum, Penman equations, Estimating equations, Seasonal variation, Simulation.

Crop growth simulation models integrate the effects of meteorological, soil, and management variables to simulate plant growth and development. Penman and Priestley-Taylor (PT) equations for estimating potential evapotranspiration (PET) were used in sorghum, wheat, and corn crop models. All models had been developed using the PT equation. Substitution of the Penman equation significantly reduced simulated yields and affected other water-related model outputs, but had little effect upon phenology. Effects were generally greatest at locations where advection is greater. During the growing season at some locations, advective energy may significantly affect PET rates and one would assume that a water balance using the Penman equation for estimating PET would be more accurate. The effects were a direct result of changing PET and, thus, soil water status. This

change in status altered model processes such as potential photosynthetic, root growth, grain filling, and leaf growth rates. These differences were greatest late in the season. Other model outputs also may have been affected. Using a modification of the PT PET equation, such as changing the alpha value or adjusting for advective effects as a function of other meteorological elements, likely would produce similar kinds of results. Users of models, therefore, need to be aware of the effects changing the PET equation can have on model outputs. (Baker-IVI)
W86-00470

TRANSPIRATION RATE AND WATER USE EFFICIENCY OF SOYBEAN LEAVES ADAPTED TO DIFFERENT CO2 ENVIRONMENTS,

Florida Univ., Gainesville. Dept. of Agronomy.
R. Valle, J. W. Mishoe, J. W. Jones, and L. H. Allen, Jr.
Crop Science, Vol. 25, No. 3, p 477-482, May/June, 1985. 5 Fig, 3 Ta, 19 Ref.

Descriptors: *Carbon dioxide, *Leaves, *Transpiration, *Water use efficiency, Water loss, Water potentials, Wind, Soybeans, Leaf temperature, Photosynthesis, Wind.

The effects of carbon dioxide on leaf transpiration, leaf resistance, leaf temperature, and water use efficiency (WUE) in soybean plants adapted to different CO2 environments were investigated. During the podfill period, the transpiration rate (TR) of soybean leaflets measured in leaf cuvettes from plants grown at 660 and at 330 micromol CO2/mol were not significantly different. Leaf resistance and leaf temperature were higher in leaflets adapted to high CO2 than those adapted to ambient CO2 levels. The similarity in leaf TR was probably the result of partial compensation due to increases in vapor pressure gradient (VPG) that canceled effects resulting from increases in leaf resistance caused by high CO2. The two-fold increase in WUE of leaflets adapted to 660 micromol CO2/mol was mainly the result of a nearly two-fold increase in photosynthetic rates on leaflets grown at high CO2 and the similarity of transpiration rates between both CO2 treatments. Photosynthetic rates accounted for 94% of the relative increase of WUE from 330 to 660 micromol CO2/mol. The CO2 concentration at which WUE is half maximum was not significantly different among leaflets adapted to either the 330 or 660 micromol/mol CO2 treatment. Leaflets adapted to high CO2 levels had higher asymptotic WUE due to a higher capacity of CO2 uptake rates and similar TR. Leaf temperature values were about 2 to 3 degrees C higher at CO2 concentrations of 990 than at 90 micromol/mol in these controlled environment curvelles, indicating a more important role of wind speed for dissipation of leaf sensible heat in high CO2 environments. (Baker-IVI)
W86-00483

RESPONSES OF C4 GRASSES TO ATMOSPHERIC CO2 ENRICHMENT. II. EFFECT OF WATER STRESS,

Duke Univ., Durham, NC. Dept. of Botany.
For primary bibliographic entry see Field 2I.
W86-00484

WATER USE EFFICIENCY OF CASSAVA. III. INFLUENCE OF AIR HUMIDITY AND WATER STRESS ON GAS EXCHANGE OF FIELD GROWN CASSAVA,

Centro Internacional de Agricultura Tropical, Cali (Colombia).
J. H. Cock, M. C. M. Porto, and M. A. El-Sharkawy.
Crop Science, Vol. 25, No. 2, p 265-272, March/April, 1985. 7 Fig, 5 Tab, 22 Ref.

Descriptors: *Water use efficiency, *Humidity, *Water stress, *Gas exchange, *Cassava, Carbon dioxide, Vapor pressure, Leaves, Water potential, Irrigation practices, Conductance, Photosynthesis.

Data is presented on the response of field grown cassava to changes in air humidity with and without soil water stress. There was a remarkable decrease in the leaf photosynthetic rate with decreasing air humidity in both well watered and unirrigated plants. A significant correlation was noted between leaf photosynthetic rate and vapor pressure differences (VPD) and leaf conductance. No correlation was noted with leaf water potential at midday and early afternoon. The midday leaf water potential of the plants without irrigation was slightly higher than that of the well watered plants. Photosynthetic rate of the plants without irrigation was always lower than the well watered ones. Transpiration initially increased with increased leaf to air VPD and then sharply declined with further increases in VPD. Leaf water use efficiency (WUE) decreased in curvilinear pattern with VPD. Dry root yield and total biomass production of cassava was increased by increasing the relative humidity in the crop canopy by artificial misting. There was a 91, 15, and 27% increase in dry root, top and total dry matter, respectively, after 40 days of misting as compared with controls. These differences in biomass production were associated with enhanced photosynthetic rate per unit leaf area of the misted plants. The leaf photosynthetic rate of cassava decreased with leaf age. Photosynthetic saturation irradiance was around 1500 and 800 micromol/sq m/sec for young and old leaves, respectively. (Baker-IVI)
W86-00485

DESIGN AND INSTALLATION OF LARGE WEIGHING LYSIMETERS,

Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
T. A. Howell, R. L. McCormick, and C. J. Phene.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 106-117, January/February, 1985. 8 Fig, 17 Ref.

Descriptors: *Design criteria, *Lysimeters, *Measuring instruments, Evapotranspiration, Estimating, Water stress, Crop growth.

The design, construction, installation, and calibration of two large weighing lysimeters are described. The lysimeters were designed to allow hourly evapotranspiration measurement, precise daily evapotranspiration measurements, evapotranspiration measurements under water stress conditions requiring a deep root zone, to permit remote data acquisition and control, and to facilitate construction and installation in a location remote from the main research office. The intended purpose of the lysimeters was to calibrate and improve combination equation potential evapotranspiration estimates, measure crop water use for several row crops, and to allow selected micrometeorological research investigations. The lysimeters were constructed in modular sections to facilitate the transport to the installation site and to minimize the use of cranes during the installation. They consisted of 5 main components: inner tank, outer tank bottom, outer tank top, access tunnel, and scale. The lysimeters were installed in a 3.6 ha field. One lysimeter was installed into a field normally used for row crop research, and the other lysimeter was installed into a grass weather station field. The resulting short term sensitivity of the lysimeter has been determined to be about 0.02 mm of evaporation (equivalent mass). The scale consists of a commercial flexure-lever action balance with a load cell final output. No counterbalance was used. The lysimeter scale appears to have excellent stability during windy conditions. (Baker-IVI)
W86-00489

AUTOMATION OF A CLASS A EVAPORATION PAN,

Agricultural Research Service, Mississippi State, MS. Crop Simulation Research Unit.
J. M. McKinion, and A. Trent.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 169-171, January/February, 1985. 5 Fig, 8 Ref.

Descriptors: *Evaporation pans, *Automation, Evaporation, Data acquisition, Stilling wells, Measuring instruments.

A pressure transducer and a stilling well were fitted to a National Weather Service Class A evaporation pan, and the system was tested for suitability for automatic acquisition of data. A ceramic differential pressure transducer (Kavlico Corp.) and a Setra Model 239E +/- 6.8 kPa unit with a stainless steel diaphragm were evaluated in separate tests. These devices provide measurements of water height in the stilling well from which pan evaporation is calculated. Output from the transducers is high-level voltage which can be measured with inexpensive voltage measuring systems. Only normal wiring precautions are needed to transmit the signal to the measurement system. Other applications involving height of a water column may benefit from the present technology, including stilling wells of flow recorders, stream gaging stations, water storage systems, livestock waterers, and spray tank monitors. (Rochester-IVI)
W86-00499

MEASUREMENT OF EVAPORATION AND TRANSPIRATION WITH LYSIMETERS,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
N. L. Klocke, D. F. Heermann, and H. R. Duke.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 183-192, January/February, 1985. 6 Fig, 3 Tab, 9 Ref.

Descriptors: *Evaporation, *Transpiration, *Evapotranspiration, *Lysimeters, Measuring instruments, Water vapor, Crops, Canopy, Soil water, Water loss, Irrigation.

A project was undertaken to evaluate different methods to measure evaporation (E), transpiration (T), and evapotranspiration (ET) in the field. Measurement techniques were sought for the field using hydraulically weighed lysimeters. The methodology used to obtain E and T measurements and the possible experimental errors associated with these techniques are considered. Sixteen hydraulically weighed lysimeters were studied. Polyethylene film, gravel, and plywood/soil covers were used to suppress soil evaporation from the lysimeters used to measure transpiration. Soil evaporation was measured in uncropped lysimeters that were either shaded or not shaded by the surrounding crop canopy. Summation of the E and T measurements overestimated measured ET by 12% to 24%. Water vapor losses through each of the lysimeter covering materials were measured in the lab. Water vapor conductances were used to estimate the lysimeter cover losses in the field. The water vapor losses through the polyethylene film, gravel and plywood/soil covers in the field were estimated to be 11%, 12%, and 6% of the measured transpiration, respectively. Soil evaporation field data were also adjusted since the crop surrouding the lysimeters for the E measurements had 102 cm rows rather than the 76 cm rows used for the E and T measurements. The summation of the adjusted E and T data were within 1% to 10% of the measured ET. (Baker-IVI)
W86-00501

MODEL TO SIMULATE RESPONSE OF PLANT STOMATA TO ENVIRONMENTAL CONDITIONS,

Hebrew Univ. of Jerusalem (Israel). Seagram Centre for Soil and Water Sciences.
R. Avissar, P. Avissar, Y. Mahrer, and B. A. Bravdo.
Agricultural and Forest Meteorology, Vol. 34, No. 1, p 21-29, February, 1985. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Transpiration, *Stomata, *Simulation, *Model studies, Solar radiation, Leaf temperature, Vapor pressure, Carbon dioxide, Soil water potential.

A semi-empirical model for predicting the stomatal response to solar global radiation, leaf temperature, vapor pressure difference between the leaf and ambient air, ambient air CO2 concentration and soil water potential was developed in order to simulate plant transpiration under different field climatic conditions. In order to determine the different empirical constants needed to run and verify the model, a series of laboratory experiments were

carried out on Nicotiana Tabaccum var. 'samsun' leaves. The plants were grown in pots in a greenhouse. The model was incorporated in a numerical greenhouse microclimate model. The greenhouse model was run for a typical spring day at the coastal region of Israel. Results obtained are in agreement with those previously published, showing that there is no significant interaction effects between the investigated environmental parameters. The use of a simple model is usually sufficient. (Moore-IVI)
W86-00504

WATER USE EFFICIENCY IN A SOYBEAN FIELD: INFLUENCE OF PLANT WATER STRESS,

National Oceanic and Atmospheric Administration, Oak Ridge, TN. Air Resources Atmospheric Turbulence and Diffusion Lab.
For primary bibliographic entry see Field 2I.
W86-00505

EVALUATING PLANT AND CANOPY RESISTANCES OF FIELD-GROWN WHEAT FROM CONCURRENT DIURNAL OBSERVATIONS OF LEAF WATER POTENTIAL, STOMATAL RESISTANCE, CANOPY TEMPERATURE, AND EVAPOTRANSPIRATION FLUX,

National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
For primary bibliographic entry see Field 2I
W86-00506

EFFECT OF STANDING STUBBLE ON SOIL WATER LOSS BY EVAPORATION,

Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
J. M. Caprio, G. K. Grundwald, and R. D. Snyder.
Agricultural and Forest Meteorology, Vol. 34, No. 2-3, p 129-144, April, 1985. 6 Fig, 6 Tab, 19 Ref. OWRT project B-046-MONT.

Descriptors: *Evaporation, *Soil water, *Stubble, Fallow, Wind, Turbulent exchange.

To assess the effects of standing stubble on evaporative water loss from wet soil surfaces during the growing season, three mini-lysimeters were installed in each of three treatment areas: fallow (bare soil), half stubble (standing stubble cut to half the height left by the combine), and full stubble (standing stubble at the height left by the combine). During the period from August 28 to September 27, 1978, prewet lysimeters containing a soil mix were set in the field between 4:30 p.m. and 5:00 p.m. The soil in the lysimeters was wet beyond field capacity, but there was no free water on the surface when installed in the field. The following day the lysimeters were removed between 4:30 p.m. and 5:00 p.m. and weighed and the depth of water computed. When rain occurred during an observation period, the data for that period were omitted from the study. Nine suitable observations were obtained from August 28 to September 1 and from September 22 to 27. The average daily evaporation for the 9 days from fallow, half stubble, and full stubble was 6.2 mm, 3.6 mm, and 3.7 mm, respectively. Statistical analyses indicated a difference in evaporation between treatments significant at the 1% level. Evaporation from lysimeters in full stubble as a percent of that from fallow lysimeters averaged 60%, and varied from day to day between about 45% and 75%. Evaporation from fallow lysimeters exceeded that from the evaporation pan by about 25%, a difference that may be attributable to the size of the evaporative surface. The reduced evaporation in stubble as compared with fallow appears to be largely attributable to the reduced wind speed and associated turbulent exchange within the standing stubble. There was a close day-to-day relationship in evaporation between the lysimeters in the various treatments. Evaporation from the half stubble and full stubble lysimeters was highly correlated, as might be expected in view of the similar nature of the two treatments. On the other hand, the relatively lower correlations of the two stubble treatments with fallow suggest that environmental factors *influencing evaporation* operate differently on fallow fields than on stubble fields. An attempt is made to describe quantitatively how environmental factors might have caused the differences in evaporation between treatments noted in this experiment. (Author's abstract)
W86-00507

ENVIRONMENTAL AND PHYSIOLOGICAL CONTROL OF TRANSPIRATION BY GROUNDNUT CROPS,

Nottingham Univ. (England). Dept. of Physiology and Environmental Science.
S. N. Azam-Ali.
Agricultural and Forest Meteorology, Vol. 33, No. 2/3, p 129-140, December, 1984. 7 Fig, 18 Ref.

Descriptors: *Peanuts, *Transpiration, *Water stress, *Plant population, Stomatal resistance, Boundary layer resistance, Leaves, Seasonal variation, Water deficit, Plant physiology.

In central India, four populations of groundnut were grown to assess the interaction between population and water stress. Transpiration was calculated from measurements or estimates of stomatal resistance, boundary layer resistance, vapor concentration difference between leaf and air, and leaf area index. The frequency distributions of stomatal resistance, boundary layer resistance, vapor concentration difference between leaf and air, and seasonal changes in leaf area index were plotted to analyze the dependence of transpiration rate on each variable, both per unit area of leaf surface, and per unit land surface. For estimates of transpiration per unit area of leaf surface, both stomatal resistance and vapor concentration difference were of similar importance, exerting a far greater influence than changes in boundary layer resistance. However, in terms of transpiration per unit land surface, changes in leaf area index were far more important than in any other variable, particularly late in the season when water was scarce. This study provides further experimental support for estimates of evaporation based on stomatal resistance and allied measurements. The ability of the technique to describe temporal and spatial variations as well as the dominant environmental and physiological influences on transpiration may outweigh any small loss in accuracy of estimates thus obtained. (Author's abstract)
W86-00508

ESTIMATING EVAPORATION: A COMPARISON BETWEEN PENMAN, IDSO-JACKSON, AND ZERO-FLUX METHODS,

Arkansas Univ., Fayetteville. Dept. of Agronomy.
A. M. Sadeghi, H. D. Scott, and J. A. Ferguson.
Agricultural and Forest Meteorology, Vol. 33, No. 2/3, p 225-238, December, 1984. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Evaporation, *Soil water, Estimation, Drainage, Soil surface, Wind, Albedo, Soil matrix potentials.

A field evaporation-drainage study was conducted to compare three methods of predicting evaporative losses from a bare soil. Two of the methods (modified Penman combination and Idso-Jackson) are dependent only on measurements of atmospheric parameters whereas the third method (plane of zero flux) is dependent only on measurements of soil parameters. A Captina soil profile was wet up and allowed to dry by evaporation and drainage. For the initial two days after infiltration ceased all three methods predicted similar evaporative losses. Differences between the three methods occurred when the soil moisture content at the soil surface controlled the evaporation rates. Under the three drying conditions the three methods behaved somewhat differently in the prediction of the amounts of water evaporated from the soil surface. Lower losses by evaporation were predicted by the Idso-Jackson and zero-flux methods. In the case of the Idso-Jackson method this result was attributed to the influence of clouds on albedo, the impact of wind and the importance of albedo in the predictive equation. For the zero-flux method the decrease in evaporation was due *to the lower soil water* contents and matrix potentials near the surface which resulted in lower transport rates of water to the surface. (Author's abstract)
W86-00509

EVAPORATION FROM WET SOIL SURFACES BENEATH PLANT CANOPIES,

Guelph Univ. (Ontario). Dept. of Land Resource Science.
G. K. Walker.
Agricultural and Forest Meteorology, Vol. 33, No. 2/3, p 259-264, December, 1984. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Soil surface, *Evaporation, *Canopy, Corn, Sensible heat, Leaves, Heat transfer.

In studies of latent heat flux from vegetated surfaces, it is often desirable to separate evaporation from the soil surface and transpiration by the vegetation. Concurrent measurements of the net radiation and evaporation from the soil surface beneath maize canopies were made for 24-hour periods, during which the soil surface remained wet. Evaporation from the soil surface often exceeded the radiant energy supply, indicating a downward flux of sensible heat. This effect was greater beneath a denser canopy. The highest value for the sensible heat component, 0.86 MJ/sq m/d, is equivalent to 0.35 mm H2O/d. The production of sensible heat at foliage elements, and its transport to the soil surface, may be important processes in overall canopy energy partitioning. Empirical methods of evaporation estimation from the soil surface beneath a canopy may not be successful under conditions where evaporation depends substantially on heat produced in the canopy and transported to the soil surface. (Moore-IVI)
W86-00510

TRANSPIRATION FROM A KIWIFRUIT VINE AS ESTIMATED BY THE HEAT PULSE TECHNIQUE AND THE PENMAN-MONTEITH EQUATION,

Ministry of Works and Development, Palmerston North (New Zealand).
W. R. N. Edwards, and N. W. M. Warwick.
New Zealand Journal of Agricultural Research, Vol. 27, No. 4, p 537-543, 1984. 3 Fig, 21 Ref.

Descriptors: *Transpiration, *Heat pulse velocity, *Kiwifruit vine, *Penman-Monteith equation, Air temperature, Vapor pressure, Wind, Stomatal conductance.

Heat pulse velocities were measured at 4 depths in the stem of a kiwifruit plant (Actinidia chinensis Planchon) throughout one late-autumn day, and sap velocities and total stem sap flux were calculated from physical principles without restoring the empirical calibration. Concurrent measurements of net radiation, air temperature, vapor pressure deficit, wind speed, and stomatal conductance were utilized in a second, independent calculation of transpiration based on the Penman-Monteith combination equation. Results indicated that most flow occurred in the outer ring or rings of the stem xylem tissue, and there was a close relationship between fluxes estimated by the 2 methods. Heat pulse velocity measurement is potentially a practicable method for measuring transpiration rates in kiwifruit. (Author's abstract)
W86-00516

2E. Streamflow and Runoff

REPORT OF FRESHWATER MOLLUSKS WORKSHOP, MAY 19-20, 1981.

Army Engineer Waterways Experiment Station, Vicksburg, MS.
For primary bibliographic entry see Field 6G.
W86-00329

HABITAT DEVELOPMENT FOR FRESHWATER MOLLUSKS IN THE TOMBIGBEE RIVER NEAR COLUMBUS, MISSISSIPPI,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 8I.
W86-00330

RUNOFF REDUCTION BY VENTING WITH SHALLOW SUBSURFACE DRAINAGE,
Pennsylvania State Univ., University Park.
R. P. Breckenridge, A. R. Jarrett, and J. R. Hoover.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 476-479, March/April, 1985. 5 Fig, 22 Ref. OWRT project A-052-PA.

Descriptors: *Soil properties, *Runoff, *Infiltration, *Subsurface drainage, Permeability, Soil water, Rain, Rainfall-runoff relationships, Drainage, Soil air.

The intensity of a rainfall event, in relation to the soil's infiltration capacity, determines how much rainwater will enter the soil as infiltration. A layer of low permeability within the soil profile can reduce infiltration if the soil air ahead of the wetting front is not vented. The effect of entrapped soil air on the rainfall-runoff relationship was investigated in a soil with an impervious layer within its profile. When the air in the soil was not vented by a drain placed just above the impervious layer, the infiltration rate was reduced from 14 to 73%, depending on the size and distribution of soil pores. As the surface soil dried and cracked, the soil air vented until the cracks filled with water. In these tests, air still remaining within the soil profile was trapped which reduced the infiltration rate after the cracks no longer vented air. The influence of depth of disturbed soil on trapped soil air and the rainfall-runoff relationship was also evaluated. The amount of voids at the beginning of tests on shallow disturbed soil was less than on deeply disturbed soil. The larger amount of voids associated with the deeper disturbed soil resulted in increased infiltration rates for a period near the start of rain; however, the larger volume of trapped air resulted in significantly greater volume of runoff. (Baker-IVI)
W86-00471

2F. Groundwater

HYDROGEOLOGICAL AND GEOTECHNICAL ASPECTS OF THE TENNESSEE-TOMBIGBEE WATERWAY,
Corps of Engineers, Mobile, AL. Mobile District.
For primary bibliographic entry see Field 8E.
W86-00334

UNWATERING THE DIVIDE CUT OF THE TENNESSEE-TOMBIGBEE WATERWAY; A MAJOR CHALLENGE TO CONSTRUCTION,
Army Engineer District, Nashville, TN.
For primary bibliographic entry see Field 8D.
W86-00335

HYDROLOGY, HYDRAULIC, AND SEDIMENT CONSIDERATIONS OF THE TENNESSEE-TOMBIGBEE WATERWAY,
Corps of Engineers, Mobile, AL. Mobile District.
For primary bibliographic entry see Field 6G.
W86-00336

GROUNDWATER MONITORING AND SAMPLE BIAS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7B.
W86-00345

GROUNDWATER DEVELOPMENT, KHARGA OASES, WESTERN DESERT OF EGYPT: A LONG-TERM ENVIRONMENTAL CONCERN,
La Moreaux (P.E.) and Associates, Inc., Tuscaloosa, AL.
For primary bibliographic entry see Field 4B.
W86-00554

DETERMINATION OF STORAGE CHARACTERISTICS AND DYNAMIC STRATA PARAMETERS THROUGH TEST WELLS (BESTIMMUNG VON SPEICHEREIGENSCHAFTEN UND DYNAMISCHEN SCHICHTPARAMETERN DURCH TESTARBEITEN),
Forschungsinstitut fuer die Erkundung Foerderung von Erdoel und Erdgas, Gommern (German D.R.).
H.-D. Voigt, and A. Astl.
Zeitschrift fur Geologische Wissenschaften, Vol. 13, No. 1, p 95-101, 1985. 5 Fig, 6 Ref.

Descriptors: *Well tests, *Groundwater storage, Drawdown, Pressure, Permeability, Hydrogeology, Geological fractures, Groundwater reservoirs.

During the test of wells, pressure drawdown and pressure buildup curves are measured, from which permeability, reserve of drainage and static pressure are determined. These curves in different ways are influenced by diverse reservoir heterogeneities, thus the particular heterogeneity may be determined by the form of the recorded curves. The identification of the reservoir heterogeneities is presented for the following four examples: - sealing faults - local changes of permeability - local natural fracturing of a reservoir - layered character of a reservoir. Such interpretation should be carried out taking into account all geological information to obtain reliable results. (Author's abstract)
W86-00587

2G. Water In Soils

PHYSICAL CHARACTERISTICS OF SOILS IN THE SOUTHERN REGION: CECIL,
R. R. Bruce, J. H. Dane, V. L. Quisenberry, N. L. Powell, and A. W. Thomas.
Southern Cooperative Series Bulletin 267, December, 1983. 185 p, 25 Fig, 82 Tab, 7 Ref.

Descriptors: *Soil profiles, *Soil water, *Permeability coefficient, *Soil surveys, *Soil physical properties, *Soil water potential, *Soil moisture retention, *Baseline studies, Soil properties, Soil horizons, Data collections, Cecil soil, Water pressure, Pore pressure, Core logging, Drainage, Alabama, Georgia, South Carolina.

As part of the Southern Regional Project S-124, in situ measurements of soil water pressure and soil water content were made in all horizons of pedons of Cecil soil in Auburn, Alabama, Watkinsville, Georgia, Clemson, South Carolina, and Blacksburg, Virgina at intervals of time during a drainage period of at least 20 days. Water retention was measured on undisturbed soil cores obtained from all horizons at 15 sampling sites. Results were used to compute unsaturated hydraulic conductivity as a function of soil water content over the range experienced during the drainage interval. The extensive soil water pressure data as a function of time and depth and the large amount of soil water content data along with information on other physical characteristics provides an excellent basis for the study of soil water retention and transport in Cecil soil and similar soil bodies.
W86-00343

COMPUTER SIMULATION OF A SPACE SAR USING A RANGE-SEQUENTIAL PROCESSOR FOR SOIL MOISTURE MAPPING,
Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
M. Fujita, and F. T. Ulaby.
Available from the National Technical Information Service, Springfield, VA 22161 as N82-32796. RSL Technical Report 551-1, April 1982. 99 p, 24 Fig, 13 Tab, 9 Ref, append. Contract/Grant No. NAS 9-26429.

Descriptors: *Simulation, *Computers, *Radar, *Soil moisture, *Mapping, Computer models, Remote sensing, SAR, Telemetry.

In this report, the ability of a spaceborne synthetic-aperture radar (SAR) to detect soil moisture is evaluated by means of a computer simulation technique. The computer simulation package includes coherent processing of the SAR data using a range-sequential processor, which can be set up through hardware implementations, thereby reducing the amount of telemetry involved. With such a processing approach, it is possible to monitor the earth's surface on a continuous basis, since data-storage requirements can be easily met through the use of currently available technology. The development of the simulation package is described first, followed by an examination of the application of the technique to actual environments. The results indicate that in estimating soil-moisture content with a four-look processor, the difference between the assumed and estimated values of soil moisture is within +/- 20% of field capacity for 62% of the pixels for agricultural terrain and for 53% of the pixels for hilly terrain. The estimation accuracy for soil moisture may be improved by reducing the effect of fading through noncoherent averaging.
W86-00351

INFILTRATION AND SOIL WATER DISTRIBUTION IN LAYERED SOILS COMPUTED BY GREEN AND AMPT AND RICHARDS MODELS,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
R. R. Bruce, and A. W. Thomas.
Presented at the 1983 Winter Meeting of the American Society of Agricultural Engineers, Paper No. 83-2501, December 13-16, 1983, Chicago, IL., 18 p. 14 Fig, 2 Tab, 22 Ref.

Descriptors: *Soil water, *Infiltration, *Soil horizons, *Model studies, *Soil profiles, *Permeability coefficient, *Soil moisture retention, *Mathematical models, Hydrologic models, Prediction, Mathematical studies, Water pressure, Pore pressure, Models.

Experience in estimating infiltration and soil water distributions by Richards, and Green and Ampt models for soils having a range in horizon characteristics is reported. The determination of appropriate hydraulic characteristics for each of three soil horizons, varying from 5 to 40 percent clay, for three soil series received major attention. The effect of magnitude and imcompatibility of soil water retention and hydraulic conductivity characteristics, at matric potentials greater than -1.5 or -2.0 kPa, upon cumulative infiltration is shown. Calculations of cumulative infiltration by the Richards model, both by changes in soil water content profile and by changes in flux, were useful in detecting data incompatibility. The results computed by each model are equally dependent on the reliability of input data for the wet range. Estimates of infiltration by the two models into Cecil, Norfolk and Gardena soil profiles, composed of surface and subsoil horizon, were similar when estimates of infiltration into the uniform systems of each of the horizons were demonstrated to be similar. When reliable estimates of infiltration were made, the rectangular wetting front predicted by the Green and Ampt model intersected that predicted by the Richards model at about one-half the soil water content range of the particular horizon. (Author's abstract)
W86-00377

GROWTH AND WATER USE OF TALL FESCUE AS INFLUENCED BY SEVERAL SOIL DRYING CYCLES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
For primary bibliographic entry see Field 2I.
W86-00459

OVERWINTER SOIL MOISTURE CHANGES,
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
D. M. Gray, R. J. Granger, and G. E. Dyck.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 442-447, March/April, 1985. 6 Fig, 2 Tab, 38 Ref.

Descriptors: *Soil water, *Seasonal variation, Temperature, Freezing, Thawing, Snowmelt, Irrigation effects, Infiltration.

Moisture migration in response to a temperature gradient during freezing and thawing of unsaturated soils is a complex process involving the thermodynamics of the soil-ice-water regime. Field studies

of the changes in the moisture regimes of some soils in the Canadian Prairies during winter show significant fluxes of moisture migration to the freezing front in both irrigated and dryland areas. The magnitudes of the fluxes are directly related to the moisture content and are greatest in the lighter-textured, irrigated soils having a water table at a relatively shallow depth. In soils which are dry in the fall the net change in the moisture status due to freezing is negligible. Overwinter moisture losses from the soil layer 0-300 mm are most common whereas gains are most frequent in a 1 m depth. The overwinter changes in the surface were independent of the moisture content at freeze-up and the average soil temperature gradient in the zone during the 60 d period following freeze-up. In dryland areas, moisture changes in a 1 m depth due to migration represent, on the average, 50% of the total seasonal change (snowmelt infiltration plus overwinter change). (Baker-IVI)
W86-00466

RUNOFF REDUCTION BY VENTING WITH SHALLOW SUBSURFACE DRAINAGE,

Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 2E.
W86-00471

THREE-DIMENSIONAL INFILTRATION AND TRICKLE IRRIGATION,

Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
For primary bibliographic entry see Field 3F.
W86-00474

FURROW COMPACTION FOR CONTROLLING EXCESSIVE IRRIGATION WATER INTAKE,

Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
For primary bibliographic entry see Field 3F.
W86-00475

INFILTRATION UNDER SURGE IRRIGATION,

Everglades Research and Education Center, Bella Glade.
For primary bibliographic entry see Field 3F.
W86-00478

HYDRAULIC POTENTIAL IN UNFROZEN SOIL IN RESPONSE TO DIURNAL FREEZING AND THAWING OF THE SOIL SURFACE,

Agricultural Research Service, Pendleton, OR. Columbia Plateau Conservation Research Center.
J. L. Pikul, Jr., and R. R. Allmaras.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 164-168, January/February, 1985. 6 Fig, 21 Ref.

Descriptors: *Soil physical properties, *Hydraulic potential, *Freezing, *Thawing, Frost, Soil water, Temperature, Crops, Vegetation effects, Microclimate.

Sub-surface hydraulic potential changes during daily freezing and thawing of soil surface were measured. The strong influence that crop residue cover has on the daily soil freezing and thawing phenomenon was demonstrated. Surface residue influence the formation of soil frost during late winter freezing and thawing cycles. During 7 consecutive diurnal freezing and thawing cycles in March, soil frost did not form under standing stubble. A bare surface froze to about 1.5 cm during each freezing night. When the soil surface (2 cm) was wet (0.34 cu m/cub m), water moved readily from subsurface layers to the freezing front. During one 6 hr freezing period, volumetric water content increased from 0.31 to 0.57 cu m/cu m at a depth of 0.25 cm. As the soil dried (0.22 cu m/cu m), water movement to the surface became negligible. Hydraulic potential at 2 cm decreased 11.4 kPa during one 7-hr freezing period on 21 March. At 13 cm, diurnal fluctuations of hydraulic potential were nearly damped out. Hydraulic potential during the 7 day period characterized water evaporation from the profile rather than drainage. Soil water evaporation was greater from the bare surface plot than from a standing stubble plot. During one 24 hr period, the bare and stubble-covered plots lost 2.4 and 0.3 mm of water, respectively, from the top 11 cm of soil. High water losses from the bare surface plot should not be considered a consequence of freezing induced water movement only. The surface cover on each plot creates a unique microclimate with different energy and radiation budgets. (Baker-IVI)
W86-00495

EVALUATING THE EFFECT OF INCREASED CONCENTRATION OF CO2 ON INFILTRATION RATE,

Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering.
A. R. Jarrett, and J. R. Hoover.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 179-182, January/February, 1985. 4 Fig, 15 Ref. OWRT project A-051-PA.

Descriptors: *Infiltration, *Carbon dioxide, *Soil water, *Hydraulic gradient, Fluid mechanics, Soil properties.

A determination was made as to whether the reduction in infiltration rates observed in soils when the natural soil air is trapped ahead of the wetting front can be reduced or eliminated by replacing the natural soil gas with carbon dioxide. The processes involved in infiltration enhancement with carbon dioxide were also investigated. The carbon dioxide gas was free to escape from ahead of the wetting front, the hydraulic conductivities were increased causing the infiltration rates to be 50% higher in the sand and 56% higher in the loam after 500 s of infiltration than those observed in identical tests using natural soil air in the same two soils. When the carbon dioxide gas was trapped ahead of the wetting front, the effect of the increased hydraulic conductivities was nullified in the sand thus reducing the infiltration rate to values as low as or lower than when the air was trapped. When the carbon dioxide gas was trapped in the loam soil during infiltration, the infiltration rate remained as high as when the carbon dioxide gas was not trapped because the exchange of hydrogen ions for calcium ions in the wetted zone increased the water filled porosity in the wetted zone by 38% thus increasing the hydraulic conductivity which increased the infiltration rates. The hydraulic gradient at the wetting front was also increased due to the reduced gas pressure. The infiltration rates increase when soil gas is provided an easy escape path. When soil air cannot be vented mechanically, practices designed to elevate the carbon dioxide levels in the soil have been shown to effectively increase the infiltration rate. Such practices include keeping soil calcium and soil carbon dioxide levels high through maintaining living, healthy cover crops. (Baker-IVI)
W86-00500

CORN YIELD VARIATION AS RELATED TO SOIL WATER FLUCTUATION AND NITROGEN FERTILIZER. I. SOIL WATER-YIELD RELATIONSHIPS,

Department of Agriculture, Quebec. Research Station.
D. Isfan.
Communications in Soil Science and Plant Analysis, Vol. 15, No. 10, p 1147-1161, September, 1984. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Soil water, *Corn, *Crop yield, Forecasting, Available water, Rainfall.

The objective of this work was to study the effect of plant available soil water (PAW) in different soil layers before and during the growing season on corn yields (Zea mays L.) and to determine if the soil water may be a reliable index in forecasting the grain yield. The experiments were carried out for 10 years at the same site on a deep-permeable well-drained chernozem with good physico-chemical and biological properties situated in a temperate-continental dry climate with annual precipitation of about 500 mm and wide seasonal and annual fluctuation. The results show that the maximum yields (MY) were highly correlated to water stored in the soil as well as at the beginning as during the growing season. In most cases the yields were better correlated to PAW at the beginning of June (r = 0.96) than at the beginning of March (r = 0.87) or July (r = 0.91). Nevertheless, the July PAW was more efficient in terms of yield per unit of PAW. Thus, 1 mm of PAW within 0-150 cm in March, June and July 1st increases the MY by 16, 21 and 30 kg/ha of grain, respectively. The MY was more related to March and especially to June 1st PAW (0-150 cm) than to June-July precipitation. The PAW from deeper soil layers was in almost all cases better correlated with MY and more efficient. Thus, for the PAW within 0-70 cm on March, June and July 1st the simple correlation coefficients with yields were 0.69, 0.87 and 0.76 respectively while for the PAW within 0-150 cm the correlation coefficients were 0.87, 0.96 and 0.91 respectively. Also, 1 mm of PAW within 0-100 cm on March, June and July 1st increased the yields by 23, 34 and 39 kg/ha while the PAW within 100-150 cm increased the yields by 40, 56 and 78 kg/ha respectively. The results suggest that in this dry area the amount of yield is higly related to PAW at the beginning as well as during the growing season and that soil water may be a good index for forecasting yields as early as three month prior to harvest, except for years with weather accidents in late summer. They also show that PAW from deeper soil layers has a paramount effect on maximum corn yield. (Author's abstract)
W86-00514

CORN YIELD VARIATION AS RELATED TO SOIL WATER FLUCTUATION AND NITROGEN FERTILIZER. II. SOIL WATER-NITROGEN-YIELD RELATIONSHIPS,

Department of Agriculture, Quebec. Research Station.
D. Isfan.
Communications in Soil Science and Plant Analysis, Vol. 15, No. 10, p 1163-1174, September, 1984. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Corn, *Crop yield, *Soil water, *Nitrogen, *Fertilizers, Available water, Multiple regression analysis, Forecasting, Water use efficiency.

The aim of this study was to determine the relationships between soil water and nitrogen fertilizer and their effect on grain corn yield (Zea mays L.) in a zone where the limiting factor of yield and nitrogen efficiency is the water supply. The experiments were carried out for 10 years on a deep-permeable well-drained chernozem in a temperate-continental dry climate with annual precipitation of about 500 mm. Different nitrogen rates were applied and plant available soil water (PAW) was determined every year before and during the growing season. Multiple regressions were fitted for nitrogen rate, soil water and corn yield. The results show that there is a significant interaction between soil water content, applied nitrogen and corn yield. The soil water explains the greatest part of yield variation, followed by the soil water-added nitrogen interaction effect and the direct effect of added nitrogen. The PAW on July 1st gave a better correlation ($R2 = 0.88$) than June 1st ($R2 = 0.85$) on March 1st PAW ($R2 = 0.72$). But the best correlation was obtained when both June and July PAW were taken together in the regression ($R2 = 0.914$). July PAW was also more efficient in terms of yield per PAW. Thus, 1 mm of PAW on March, June and July 1st increased the control yield by 12.5, 14.6, and 18.3 kg grain/ha respectively, and by 18.0, 22.0 and 32.0 kg grain/ha for the fertilized yield (with 60 kg N/ha). At low soil moisture content, the applied N had no or even negative effect on water use efficiency and yield while at high PAW the water use efficiency was greatly increased by the applied N. (Author's abstract)
W86-00515

2H. Lakes

PRELIMINARY GUIDE TO THE ONSITE IDENTIFICATION AND DELINEATION OF

THE WETLANDS OF THE NORTH ATLANTIC UNITED STATES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. T. Huffman, G. E. Tucker, J. W. Wooten, C. V. Klimas, and M. W. Freel.
Technical Report Y-78-8, May 1982. Final Report. 53 p, 5 Fig, 81 Ref, 1 Append.

Descriptors: *Wetlands, *Hydrology, *Vegetation, *Soil-water-plant relationships, *Plant populations, Bogs, Swamps, Marshes, Lakes, Aquatic habitats, Aquatic plants, Glacial soils, Bottomland, Flood plains, Saline water, Forests, Streambeds, Shores.

This guidebook is intended to help regulatory personnel with the onsite recognition and geographical delineation of wetland boundaries in the North Atlantic United States. The introduction includes general information about wetlands. Major lowland areas are the Seaboard Lowlands of New England, the Ontario Plain in New York, and the large-river valleys: Connecticut, St. Lawrence, Mohawk, and Hudson. Numerous ponds, lakes, swamps, and bogs exist as a result of impervious underlying rock, coarse acidic soils, and glaciation effects. Climatic parameters are highly variable. However, inland areas are usually cool and humid with an average of 102 cm of precipitation each year. Tropical storms have caused major damage in southeastern New England forests. Indicators are described for determining whether vegetation, soil, and hydrological conditions are typically wetland. Wetlands are classified into several groups, each with characteristic vegetation. Aquatic bed wetlands have vegetation which grows on or below the water surface for most of the growing season. Emergent wetlands have erect, rooted, herbaceous hydrophytes (excluding mosses and lichens), mostly perennial. Scrub-shrub wetlands and forested wetlands have woody vegetation less than 6 m high. The streambed class includes nontidal channels containing water for part of the year. Unconsolidated shores have unconsolidated substrates, 30% or less vegetation cover, flooded intermittently.
W86-00316

BENTHIC MACROINVERTEBRATES OF SELECTED AQUATIC HABITATS OF THE LOWER MISSISSIPPI RIVER,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
D. C. Beckett, C. R. Bingham, L. G. Sanders, D. B. Mathis, and F. M. McLemore.
Technical Report E-83-10, April 1983. Final Report. 79 p, 15 Fig, 15 Tab, 43 Ref, 2 Append.

Descriptors: *Aquatic insects, *Macroinvertebrates, *Aquatic animals, *Aquatic habitats, *Benthos, Floods, Mississippi River, River flow, Water currents, Mud, Silt, Sand, Gravel.

Benthic macroinvertebrates distribution in four aquatic habitat types (a natural bank, secondary channel, an abandoned channel, and dike fields) within a 60-mile reach of the lower Mississippi River over one high flow (flood stage), two moderate and two low flow periods between April 1979 and September 1980 is described. The biotas present in the natural bank and in the secondary and abandoned channels showed only minor changes in composition over the various flow regimes. The natural bank was consistently dominated (numerically) by the burrowing mayflies Tortopus incertus and Pentagenia vittigera and hydropsychid caddisflies. The consistently most common taxa in the secondary channel were the sand-dwelling chironomids Robackia claviger and Chernovskiia orbicus. Phantom midges, tubificid oligochaetes, and fingernail clams were always the most abundant macroinvertebrates in the abandoned channel. Macroinvertebrate densities were always high in the mud-bottomed abandoned channel and were always low in the secondary channel. The dike fields showed large changes in biotic composition, which correlated with changes in river stage and resultant alterations in current and substrate. With decreased river stages, substrate dominance changed from erosional (sand and gravel) to depositional (silt). It is concluded that the distribution of macroinvertebrates in the Lower Mississippi River habitats is a function of the physical characteristics (current velocity and substrate composition) of the system. (Author's abstract modified)
W86-00324

INSTRUCTION REPORT ON FRESHWATER MUSSELS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
A. C. Miller, and D. A. Nelson.
Instruction Report EL-83-2, September 1983. Final Report. 198 p, 22 Fig, 42 Tab, 394 Ref.

Descriptors: *Mussels, *Bivalves, *Mollusks, Commercial fishing, Relocation, Reviews, Sampling, Computer program, Habitats.

This report contains information on the following topics: collecting, preserving, and identifying freshwater mussels; methods for relocating and creating habitat for mussels; the commercial shell industry; and the technical literature concerning mussels. This information will aid in performing impact assessments and endangered species surveys. Techniques for determining the number of samples required to provide a fairly accurate estimate of a population mean are discussed. The simplest and fastest is to calculate cumulative means for a particular species collected in a series of samples. The resulting curve will eventually stabilize near the mean of the population. A more accurate technique is to conduct a pilot survey, determine the average and standard deviation of the sample, and decide what degree of precision is required. Based upon the pilot survey, it is possible to make an estimate of the number of samples needed to satisfy the particular criteria desired. The diversity of the habitat and likelihood of capturing additional, less common, species can be determined by plotting cumulative species versus cumulative individuals. A computer program has been developed which can provide assistance in determining the number of samples required. The program can simulate cluster, random, or uniform distribution patterns. Using random numbers, the program then 'samples' the array and calculates sample means and standard deviation.
W86-00325

VERIFICATION AND TRANSFER OF THERMAL POLLUTION MODEL; VOLUME IV: USER'S MANUAL FOR THREE-DIMENSIONAL RIGID-LID MODEL,

Miami Univ., Coral Gables, FL. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W86-00346

USE OF VEGETATION IN DELINEATING WETLAND BORDERS IN UPPER MISSOURI RIVER BASIN; NORTH-CENTRAL UNITED STATES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
W. C. Johnson, R. A. Mayes, and T. L. Sharik.
Technical Report Y-82-1, Army Engineer Waterways Experiment Station, Vicksburg, MS., August 1982. Final Report. 132 p, 15 Fig, 5 Tab, 14 Ref, 3 Append. Contract/Grant No. DACW39-78-C-0098.

Descriptors: *Wetlands, *Vegetation, *Transition zone, *Sampling, *Upper Missouri River Basin, Species composition, Species diversity, Plant populations, Graphical analysis, South Dakota.

Wetland-nonwetland transition zones in the Missouri River Basin of the North-central United States were studied in seven wetlands ranging in size, permanence, and salinity to develop an efficient sampling methodology that utilized vegetatation data to delineate wetland boundaries. One hundred and sixty species of vascular plants occurred in twenty sample transects. Sampling methodology suggested for use in the study area (200-km radius of Sioux Falls, South Dakota) is a combination of the belt transect method (contiguous quadrants) to estimate cover by species and a cover board to measure vertical structure. The methods require a combined sampling time of about 9 minutes/m of transect, corresponding to a sampling time of 3.2 hr for a transect of average length. A streamlined methodology was also devised whereby sampling time could be cut in half. General upper and lower borders of the transition zone were determined from direct gradient analysis graphs. Specific borders were determined from the occurrence of compositional dichotomies displayed in ordination models. The upper border of the transition zone is suggested as the most probable wetland border. This border appears to represent the upper limit of disturbance from wetland processes (siltation during drawdown, ice scouring, variable surface and subsurface hydrologic regime). The transition zone (between emergent aquatic and low prairie zones) is strongly influenced by wetland disturbances and, therefore, contains a large proportion of opportunistic, ruderal species. The lower border of the transition zone is highly variable annually, while the upper border appears to be relatively stable.
W86-00359

INFLUENCE OF THE FISH CLARIAS BATRACHUS ON THE PHYSICOCHEMICAL PROPERTIES OF WATER UNDER LABORATORY CONDITIONS,

Kalyani Univ. (India). Dept. of Zoology.
B. B. Jana, M. Sinha, and S. Gupta.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 1, p 107-113, 1984. 2 Tab, 11 Ref.

Descriptors: *Physicochemical properties, *Fish, *Nutrients, Aquaculture, Fish farming, Phosphorus, Nitrogen, Chlorides, Hydrogen ion concentration, Carbon dioxide, Dissolved oxygen.

An attempt is made to measure the changes of physicochemical characteristics of water affected by the different metabolic states of Clarias batrachus under laboratory conditions, as part of a study into production of air-breathing fish. A distinct acidic environment in the water of experimental aquaria was encountered because the values of pH and free CO2 were markedly different between the experimental aquaria and the control. There was a reduced level of oxygen in the experiment aquaria compared to the control. The variations of pH and free CO2 among experimental variants were very minor and could not be accounted for by the differences in the metabolic states of fish. The chloride input through fish excrement in the larger and fed fishes may be much higher compared to the smaller and starved fishes. Food pellets were an important source of chloride in the water. The phosphate content in the experimental aquaria was significantly higher than in the control, which suggests that a significant phosphate loading was ocurring in these aquaria mainly through the droppings of fish. The nitrogen excretion rate was distinctly higher in the large fishes of Clarias batrachus than in their smaller counterparts and these carnivorous fishes have a major role in the nitrogen input of the habitat. The population of heterotrophic and ammonifying bacteria was distinctly higher in the aquaria with large fed fishes compared to other groups of fishes. (Baker-IVI)
W86-00401

CHEMICAL AND PHYSICAL CHARACTERISTICS OF SOME WETLAND WATERS OF KASHMIR,

Kashmir Univ., Srinagar (India). Dept. of Botany.
S. Kaul, and C. L. Trisal.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 2, p 137-144, 1984. 2 Fig, 1 Tab, 15 Ref.

Descriptors: *Jammu and Kashmir, *India, *Wetlands, *Physicochemical characteristics, Nutrients, Carbon dioxide, Water temperature, Vegetation, Seasonal variation, Dissolved oxygen, Calcium, Magnesium, Alkalinity, Nitrogen.

Ecosystem analyses of five important wetlands in the Kashmir Valley have been undertaken. The annual cycle of the surface water temperature in the study sites showed a close relationship to that of air temperature. The temperature increased from a spring low to a summer high followed by a decrease until minimum values are recorded in

winter. Oxygen values showed an inverse relationship to temperature. Of the divalent ionic components in different wetland sites, Ca and Mg are the most abundant. The concentration of free carbon dioxide is very low, the dissolved inorganic carbon necessary for photosynthesis being obtained from bicarbonates. The wetland waters are alkaline with pH ranging between 7.2 and 9.6. NO3-N is the most abundant nitrogen source at the present sites. The increase in NO3-N concentration towards winter and early spring may be attributed to the combined result of nitrification at the mud-water interface and the vigorous stirring of wetland waters which eliminates any limiting effects of oxygen diffusion. Both NO2-N and NH3-N are present in low amounts in comparison to NO3-N. In all the five wetlands the time variation and station differences are highly significant. There were however, two exceptions: the site difference was not significant for the water temperature, and time variation, site differences and station differences were not significant in case of alkalinity. (Baker-IVI)
W86-00405

INTENSIVE CARP REARING IN LAKES AND EUTROPHICATION (KARPFENINTENSIVBEWIRTSCHAFTUNG VON SEEN UND EUTROPHIERUNG),

Bezirks-Hygieneinspektion und -Inst., Potsdam (German D.R.).
For primary bibliographic entry see Field 5B.
W86-00406

PROBLEM OF INTENSIVE CARP REARING IN LAKES AND EUTROPHICATION (ZUR FRAGE DER KARPFENINTENSIVBEWIRTSCHAFTUNG VON SEEN UND EUTROPHIERUNG),

Institut fuer Binnenfischerei, Berlin (German D.R.).
For primary bibliographic entry see Field 5B.
W86-00407

INVESTIGATIONS ON THE INFLUENCE OF LIMNIC MACROPHYTES ON THE DYING RATE OF ESCHERICHIA COLI IN WATER (UNTERSUCHUNGEN ZUM EINFLUSS LIMNISCHER MAKROPHYTEN AUF DIE ABSTERBEGESCHWINDIGKEIT VON ESCHERICHIA COLI IM WASSER),

Medizinische Akademie 'Carl Gustav Carus' Dresden (German D.R.).
G. Burger, and G. Weise.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 3, p 301-309, 1984. 5 Fig, 5 Tab, 9 Ref.

Descriptors: *Escherichia, *Macrophytes, *Antibacterial action, Bioassay, Aquatic plants, Bacteria.

In bioassays in aquaria, the death of Escherichia coli was accelerated by the presence of Glyceria maxima, Schoenoplectus lacustris, Alisma plantago-aquatica and Mentha aquatia as compared with check tanks without any plants (initial concentration 15 x 10 to the 9th colony-forming units per ml). As expected, the antibacterial effect of the limnic macrophytes attains it maximum effectiveness within the first days of the period of investigation. The 90% reduction time is shortened by one third to half, and the 99% reduction time is shortened by one fourth to one third. Mean contact times of 7-11 h are required for the decimation of bacteria by 90% and mean contact times of 16-19 h are necessary for a 99% reduction of the population. The antibacterial effect in mixed stands of different plant species possibly increases additively or superadditively. (Author's abstract)
W86-00414

STUDIES ON PRIMARY PRODUCTIVITY AND SOME HYDROCHEMICAL ASPECTS OF A POLLUTED WATER-BODY OF THE HIMALAYAN JHELUM VALLEY,

Jos Univ. (Nigeria). Dept. of Botany.
M. A. Khan.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 5, p 539-548, 1984. 8 Fig, 23 Ref.

Descriptors: *Primary productivity, *Lakes, *Jhelum Valley, *Jammu and Kashmir, India, *Trigamsar, Stratification, Temperature, Seasonal variations, Visibility, Turbidity, Phytoplankton, Eutrophication.

The Valley of Kashmir is a lacustrine basin of the inter-montane depression existing between the Lesser and the Great Himalaya. A study was undertaken of the culturally polluted lake Trigamsar for a period of 22 months to evaluate the seasonal variations in the hydrobiological features and to evaluate relationships between the biota and the habitat. During the summer, the surface water temperatures reach as high as 30 C with a sharp decline in the deeper layers. These relatively high temperature values are due to the absorption of heat by the biogenic turbidity of Trigamsar. The oxygen concentration in the suface water varied between 7.6 and 14.5 mg/l throughout the study period. Despite the shallow basin, Trigamsar develops a significant vertical oxygen gradient during March-October. During summer the waterbody was characterized by a typical clinograde oxygen curve indicative of an accelerated eutrophication of the ecosystem. The surface lake water remained supersaturated with oxygen during the greater part of the year. The pH ranged from 8.1 to 9.9 and total alkalinity was principally of the bicarbonate type and fluctuated between 345 and 480 mg/l. Secchi transparency ranged from 0.25 to 0.60 m during the study with higher values being obtained during the winter and the minimum in summer. Lake water is quite turbid. A pronounced seasonal cycle in the phytoplankton production was observed which closely paralleled the seasonal cycle of temperature and light. The values for the photosynthetic efficiency in the water body fluctuated between 0.42 and 2.85% with higher values obtained during summer and the lowest in winter. The phytoplankton population of the Trigamsar was predominantly of Cyanophyceae followed by Chlorophyceae and Bacillariophyceae. (Baker-IVI)
W86-00420

SENSITIVITY OF SOUTHERN QUEBEC LAKES TO ACIDIC PRECIPITATION,

Quebec Univ., Sainte-Foy.
For primary bibliographic entry see Field 5C.
W86-00427

SEDIMENT ACID NEUTRALIZATION IN SOFTWATER LAKES,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
L. A. Baker, P. L. Brezonik, E. S. Edgerton, and R. W. Ogburn, III.
Water, Air, and Soil Pollution, Vol. 25, No. 2, p 215-230, 1985. 7 Fig, 5 Tab, 36 Ref.

Descriptors: *McCloud Lake, *Florida, *Lake sediments, *Acidity, *Neutralization, Softwater lakes, Sediments, Calcium, Magnesium, Volatile solids, Storm seepage, Acidification.

The mechanisms and potential magnitude for sediment acid neutralization in softwater lakes was examined. The principal site for this study was McCloud Lake, a small softwater lake in Florida. The lake and its watershed receive minimal human disturbance. The lake is a simple shallow doline that does not stratify thermally and has no inlet or outlet. The lake received 90% of its water from rainfall during 1981-82 and the remainder from subsurface seepage. The littoral sediments are sand interspersed with pockets of peaty material, while the profundal sediments are a highly organic ooze up to 6 m thick. Sediments from seven other lakes in Wisconsin and Florida were used for comparison purposes. Acid neutralizing capacities of sediments from these lakes were as high as 10 meq/100 g over the pH range 4.5 to 5.5 in well mixed batch experiments. Exchange of $Ca(2+)$ and $Mg(2+)$ accounted for over 50% of the neutralizing capacity. Al solubilization and sulfate adsorption were unimportant in neutralizing $H(+)$ additions. Acid neutralizing capacity was correlated with sediment volatile solids content. Sulfate reduction occurred in microcosms that simulated lake-water interactions and subsurface seepage. In situ pore water profiles and a whole-like mass balance confirm the occurrence of this process in McCloud Lake. Sediment neutralization is important for lakes that receive most of their water from precipitation and thus are particularly susceptible to acidification. (Baker-IVI)
W86-00432

ARTICULATION, ACCURACY AND EFFECTIVENESS OF MATHEMATICAL MODELS: A REVIEW OF FRESHWATER WETLAND APPLICATIONS,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. Costanza, and F. H. Sklar.
Ecological Modelling, Vol. 27, No. 1/2, p 45-68, March, 1985. 2 Fig, 4 Tab, 65 Ref.

Descriptors: *Model studies, *Wetlands, *Effectiveness, *Optimization, *Mathematical models, Articulation, Accuracy.

Eighty seven mathematical models of freshwater wetlands and shallow water bodies were classified by wetland type, location, and degree of nonlinearity, and rated by three new indices: articulation; accuracy; and effectiveness. Articulation measures the size and complexity of the model in the three modes of components, space, and time. Accuracy combines measures of goodness-of-fit in each mode. Effectiveness measures explanatory power as a combination of articulation and accuracy. Accuracy fell in the models investigated with increasing articulation. This may be a result of increasing complexity and cost. The maximum effectiveness was achieved at intermediate articulation. Effectiveness fell with highly accurate models indicating that such models tend to be low in articulation while highly articulate models tend to be low in accuracy. Such ranking of models may provide a useful guide to model builders who are concerned with maximizing the effectiveness of their models and making use of limited resources. (Baker-IVI)
W86-00433

PHOSPHORUS AND NITROGEN EXCRETION BY LAKE ZOOPLANKTON (ROTIFERS AND CRUSTACEANS) IN RELATIONSHIP TO INDIVIDUAL BODY WEIGHTS OF THE ANIMALS, AMBIENT TEMPERATURE AND PRESENCE OR ABSENCE OF FOOD,

Polish Academy of Sciences, Lomianki. Inst. of Ecology.
J. Ejsmont-Karabin.
Ekologia Polska, Vol. 32, No. 1, p 3-42, 1984. 16 Fig, 3 Tab, 66 Ref.

Descriptors: *Phosphorus, *Nitrogen, *Zooplankton, *Lakes, Temperature effects, Cladocera, Copepoda, Rotatoria, Excretion, Nutrients, Food.

The relationship has been determined between the specific rate of P and N excretion by plankton rotifers and crustaceans, and ambient temperature and individual body weights. The rate of excretion is strongly dependent on the temperature, this relationship being of exponential nature. Over the temperature range 10-35 C the Q-10 for the rate of phosphorus excretion was 2.6, for nitrogen -2.4. A power relationship has also been demonstrated between the rate of excretion of both the elements studied and the individual body weight of animals representing three taxonomic groups: rotatoria, cladocera and copepoda. A greater decrease - following an increase in animal body weight - in the rate of the excretion of phosphorus than of nitrogen causes an increase in the N:P ratio in excretion products following a growth of body weight. Starvation of animals prior to measurement caused a decrease in the excretion rate: 1.9 fold in the case of P and 2.2 fold in the case of N. Using the results of this study and some literature data it was possible to build equations describing the effect of body weight and temperature on the rate of P-PO4 excretion. (Baker-IVI)
W86-00435

BIOMASS OF MACROPHYTES IN THE CHANNEL RUNNING THROUGH AGRICULTURAL AREAS,

Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
H. Goldyn.
Ekologia Polska, Vol. 32, No. 1, p 167-176, 1984. 1 Fig, 5 Tab, 15 Ref.

Descriptors: *Macrophytes, *Channels, *Biomass, Poland, Drainage channels, Aquatic plants, Vegetation, Seasonal variation.

The results of investigations on the biomass of macrophytes conducted in the vegetation season in 1979 in the channel running out from a lake and draining the water from meadows and fields near Turew, Poland are reported. Sparganium simplex and Elodea canadensis were dominant species of vascular plants. The biomass was estimated once a month between June and September for S. simplex, and between June and October for E. canadensis. The maximal biomass of above ground parts of S. simplex was recorded in August, whereas the total biomass of underground parts of this species increased during the whole period of investigations. The biomass of E. canadensis increased during the vegetation season till it attained the maximum in September. The mean biomass of S. simplex during the maximal growth of aboveground parts was 28.0 g dry wt/sq m, whereas the highest one was 85.2 g dry wt/sq m, and the biomass of underground parts was 40% of total biomass. The mean biomass of E. canadensis was 49.4 g dry wt/sq m, whereas the maximal biomass was 426 g dry wt/sq m. The biomass of underground parts was 2.3% of total biomass. The total biomass of all macrophytes growing in the channel, on the average, in plant patches, was 82.02 g dry wt/sq m, whereas on the entire length of the channel part examined including the areas not colonized by vascular plants, it was 30.25 g dry wt/sq m. The biomass of underground parts was 16.3% of total biomass. The majority, that is 83.9% of biomass, of underground parts was produced by S. simplex. (Baker-IVI)
W86-00436

FACTORS INFLUENCING INORGANIC TURBIDITY IN A GREAT PLAINS RESERVOIR,

Oklahoma State Univ., Stillwater. Dept. of Zoology.
S. L. Nolen, J. Wilhm, and G. Howick.
Hydrobiologia, Vol. 123, No. 2, p 109-117, April, 1985. 4 Fig, 2 Tab, 38 Ref.

Descriptors: *Reservoirs, *Lake Carl Blackwell, *Oklahoma, *Turbidity, *Opacity, Secchi disc, Fetch, Runoff, Sedimentation, Wind, Rainfall, Model studies, Sediments, Water depth.

Nephelometric and Secchi disc turbidities were measured at 16 sampling sites at Lake Carl Blackwell, Oklahoma on 54 dates from 12 February 1982 to 24 January 1983. Measurements of precipitation, wind velocity, effective fetch, water depth, and sediment particle size were also recorded. Turbidity values ranged from 16 to 1140 NTU and Secchi disc transparency from 2 to 110 cm. Large fluctuations in nephelometric turbidity in upper reaches during early summer resulted from sediment inputs from runoff following heavy May rains. Horizontal gradients of turbidity change during runoff can be attributed to the rapid settling of coarse-grain suspended materials prior to transport to deep-water stations. While sediment inputs from runoff resulted in large turbidity increases during the study, inflow is probably less important in the regulation of turbidity on a long-term basis. Under extremely turbid conditions, drastic increases in nephelometric turbidity resulted in only minimal changes in Secchi disc transparency. Multiple regression models relating nephelometric turbidity to measured climatological and morphometric parameters in the reservoir were constructed. A single easily-measured variable that integrated important parameters influencing sediment resuspension was also developed. Resuspension is primarily a function of wave height and water depth. Cumulative values of rainfall for 1 to 5 days preceeding sampling were correlated with turbidity. A much more useful and practical turbidity model was constructed using data collected prior to heavy rains. (Baker-IVI)
W86-00440

RELATIONSHIPS BETWEEN ZOOPLANKTON ABUNDANCE AND TROPHIC STATE IN SEVEN NEW ZEALAND LAKES,

Waikato Univ., Hamilton (New Zealand). School of Science.
M. A. Chapman, J. D. Green, and V. H. Jolly.
Hydrobiologia, Vol. 123, No. 2, p 119-136, April, 1985. 11 Fig, 12 Tab, 49 Ref.

Descriptors: *Zooplankton, *Lakes, *Rotorua, *New Zealand, Trophic level, Population dynamics, Copepods, Cladocera, Crustaceans, Population dynamics.

Zooplankton communities were studied in 1977-78 in lakes of different trophic status in Rotorua, New Zealand. In six of the seven study lakes, the zooplankton was usually dominated by calanoid copepods but even in Lake Tikitapu calanoids were of similar abundance to cladocerans. Such a predominance of calanoid copepods is typical of many New Zealand lakes though cladocerans may be seasonally more abundant in some cases. There does not seem to be a clear-cut relationship between trophic status and the type of community. Despite the similarities in species composition in the study lakes they clearly differed in the abundance of zooplankton with the greatest contrasts between Lakes Okaro and Ngapouri, where numbers were generally highest, and Lake Tikitapu in which populations were very much smaller. Certain features were common to all. Population sizes varied during the year by less than an order of magnitude in contrast to fluctuations over two or three orders in perennial species in northern hemisphere temperature lakes. The fluctuations that did occur varied between the lakes with no common pattern. A third feature was the continuously low clutch sizes and often low percentages of breeding females found in all the crustacean species. In both the cluster analyses and the principal component analysis the differences between the lakes were most marked in the warmer months particularly when the volumetric data were tested. The greater sensitivity of these data presumably reflects the importance of nutrient dilution in relation to plankton productivity. The use of zooplankton as integrators of biological conditions avoids the problems of interpreting data influenced by morphometric features of lakes such as hypolimnetic oxygen deficits or macrobenthos standing crops, while the long generation times of copepods in particular enable less frequent sampling than is required for phytoplankton. (Baker-IVI)
W86-00441

SPRING BENTHIC MACROINVERTEBRATE COMMUNITIES OF SELECTED STREAMS IN THE HIGH CAUCASUS (AZERBAIJAN SSR),

Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Kownacki.
Hydrobiologia, Vol. 123, No. 2, p 137-144, April, 1985. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Invertebrates, *Streams, *Caucasus, *Azerbaijan SSR, *USSR, Population dynamics, Fauna, Aquatic insects.

Invertebrates were collected at fifteen sites in streams of the Caucasus (Azerbaijan SSR) in March of 1970: 75 taxa of invertebrates were found. The most numerous group, as far as number of taxa and abundance of specimens are concerned, was Chironomidae. Usually their quantity exceeded 50% of the total abundance of invertebrate fauna and at some sites, even 90%. Ephemeroptera, Plecoptera, and Simuliidae were the other important components of the fauna. The total abundance of the fauna differed greatly at particular sites. Least abundance was recorded in the stream Kishchay and its tributary Domarchynchay. Greatest abundance was found in a nameless tributary of the stream Dagirmanchay. The total abundance of the fauna usually varied at particular sites from 300 to 900 specimens. Four community groups were distinguished. It was determined that spring time in high mountain streams and rivers was more conducive to the development of the invertebrate fauna. (Baker-IVI)
W86-00442

CHARACTERIZATION OF BENTHIC MICROHABITAT; AN EXPERIMENTAL SYSTEM FOR AQUATIC INSECTS,

Illinois Univ. at Urbana-Champaign. Dept. of Urban and Regional Planning.
L. L. Osborne, E. E. Herricks, and V. Alavian.
Hydrobiologia, Vol. 123, No. 2, p 153-160, April, 1985. 5 Fig, 2 Tab, 26 Ref.

Descriptors: *Benthos, *Microhabitats, *Aquatic insects, Insects, Population dynamics, Thermistors, Flow velocity, Streams, Channels, Benthic environment, Habitats.

An experimental system used to determine microhabitat current velocity and microhabitat selection by aquatic insects is described. The system includes a microvelocity probe and a hydraulically calibrated artificial substrate. A thermistor velocity probe detects flow velocities to 0.5 m/sec near the surface of substrates at locations inhabited by aquatic insects. The artificial substrate was designed to provide two major habitat types, highly turbulent vortex areas and region with unidirectional, near laminar flow. Substrate calibration and microhabitat characteristics of the substrates are demonstrated. Experimental studies of Simulium sp. location on substrates indicated that while simuliid larvae are characteristic of lotic, erosional habitats, actual microhabitats selected are governed by substantially lower flow velocity. One major advantage of the system is that once a substrate configuration is hydraulically analyzed and calibrated, the calibration will not change. Standard substrates can be used in a number of field situations providing similar information for a number of taxa. The system also permits determination of microhabitat velocity with minimal disturbance to the organism. Experimental studies of aquatic insect behavior, evaluations of competition, and general descriptions of life history and environmental relationships may all be enhanced through the use of such a system. Critical microhabitat variable(s) can be kept constant allowing careful evaluation of the effects of either chemical or biological modification of environmental conditions on aquatic insects. (Baker-IVI)
W86-00443

REACTION OF LARVAE OF SIMULIUM NOELLERI (DIPTERA) TO DIFFERENT CURRENT VELOCITIES,

London Univ. (England). Dept. of Biological Sciences.
R. S. Wotton.
Hydrobiologia, Vol. 123, No. 3, p 215-218, 1985. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Water currents, *Behavior, *Aquatic insects, Blackflies, Larvae, Velocity, Animal behavior, Insect behavior.

Experiments were conducted to determine whether larvae of different sizes of Simulium noelleri reacted differently to a range of current velocities, using the extent of upstream movement by looping as an indication of differences. As current velocity decreased, a significantly higher percentage of larvae moved more than 50 cm upstream in the course of 90 minutes. In studying the size of larvae which moved more than 10 cm upstream from where they had been placed, overall length measurements were grouped into categories and the percentage of the total number of larvae within each size category which moved more than 10 cm upstream after at least 90 min, had elapsed was plotted against current velocity. The larger a larva becomes the more likely it is to move upstream in lower water velocities, or, conversely, smaller larvae have a greater tolerance of low velocities. Concerning the distance travelled by larvae per unit time, the maximum speed of upstream migration was recorded in four of the experiments when, in each case, one larva moved 40 cm upstream at a rate of .067 cm/sec. Speeds of over .06 cm/s were commonly recorded in the first ten minutes of experiments. (Baker-IVI)
W86-00445

EFFECTS OF METAL SPECIATION ON GROWTH OF PHYTOPLANKTON WITH SPECIAL REFERENCE TO IRON,

Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 5C.
W86-00455

SURVEY OF THE DISTRIBUTION OF CHIRONOMIDAE (DIPTERA, INSECTA) OF THE RIVER RHINE BY SAMPLING PUPAL EXUVIAE,

Bristol Univ. (England). Dept. of Zoology.
R. S. Wilson, and S. E. Wilson.
Hydrobiological Bulletin, Vol. 18, No. 2, p 119-132, December, 1984. 4 Fig, 4 Tab, 36 Ref, 1 Append.

Descriptors: *Rhine River, *Midges, *Distribution, Europe, Aquatic insects, Population dynamics, Water pollution effects, Species composition, Ecological distribution, Sediments.

The Rhine rises in the Swiss Alps and discharges to the North Sea. In 1981, the Rhine was sampled for chironomid pupal exuviae. The Grande Canal d'Alsace and selected tributaries were also sampled. In the 78 samples taken, 9771 exuviae were examined and 135 taxa identified. A species list shows the distribution of taxa between the principal regions of the river. Above the Bodensee the Rhine has a diverse fauna dominated by Orthocladiinae. The Hochrhein near the entry of the River Aare, and the River Aare itself, also have a diverse fauna, but include many sediment dwelling Chironominae. Below Strasbourg the fauna changes markedly, losing most of its sediment dwellers, and shows a great increase of pollution tolerant strains. The fauna generally becomes less diverse and of poorer quality throughout the Oberrhein sections, and faunal changes are related to the inflow of the Rivers Neckar and Main. Samples from the Mittelrheingorge and the Niederrhein are generally dominated by two species of Rheotanytarsus and show a progressive reduction of diversity coupled to an increase of pollution tolerant species. The low proportions of sediment dwellers in the Niederrhein and the Waal, suggests that the sediments are unsuitable for the support of a normal chironomid fauna, possibly through the accumulation of toxic materials. (Baker-IVI)
W86-00457

LONGITUDINAL DISTRIBUTION OF MACROINVERTEBRATES AND FISH IN A LOWER NIGER DELTA RIVER (RIVER SOMBREIRO) IN NIGERIA,

Port Harcourt Univ. (Nigeria). Dept. of Zoology.
C. S. Nwadiaro.
Hydrobiological Bulletin, Vol. 18, No. 2, p 133-140, December, 1984. 1 Fig, 3 Tab, 23 Ref.

Descriptors: *Macroinvertebrates, *Fish, *Niger River, *Sombreiro River, *Nigeria, *Spatial distribution, Distribution patterns, Streams, Rivers, Aquatic insects, Crustaceans, Mollusks, Annelids, Arachnids, Water chemistry.

Samples were taken monthly from November 1979 to June 1982 at six stations located along the River Sombreiro, Nigeria. The macroinvertebrate community was dominated by Crustacea and Insecta, followed by mollusks, annelids and arachnids. Their respective contributions to the taxonomic composition of the river were 36%, 34%, 15%, 9%, and 6%. The Crustacea were virtually restricted to the downstream brackish water stations where they were very abundant and taxonomically more diverse. The mollusks were found exclusively in the lower and alkaline zone of the river. The location of the fish and division by species further confirms the roughly divided two zones of the river with the physicochemical, macroinvertebrate and ichthyofaunal boundaries located between Lat. 4 degrees 55 minutes and 4 degrees 48 minutes N and Long. 6 degrees 42 min and 6 degrees 47 min E. The upper zone has insects, oligochaetes and arachinids as the dominant invertebrate fauna and the dwarf cichlids as its diagnostic fish species. The lower zone has Crustacea and Mollusca as the cardinal invertebrate fauna and the monodactylid Monodactylus sebae as its distinctive fish type. The dominating factors in the zonation of the river into two zones are mainly chemical (salinity, alkalinity, total hardness) and to a much less extent physical (current velocity and the associated substrate composition). (Baker-IVI)
W86-00458

USE OF DIALYSIS CELLS FOR INVESTIGATING PORE WATER COMPOSITION IN WETLAND SUBSTRATA, WITH PARTICULAR REFERENCE TO DISSOLVED IRON AND SULPHIDE,

Sheffield Univ. (England). Dept. of Botany.
B. D. Wheeler, and K. E. Giller.
Communications in Soil Science and Plant Analysis, Vol. 15, No. 6, p 707-716, June, 1984. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Dialysis cells, *Sampling, *Interstitial water, *Wetlands, Iron, Sulfides, Peat, Anaerobic conditions, Substrate.

A dialysis method is described for sampling pore water from depth in wetland substrata (peats). The method is designed particularly to permit collection of large sample volumes (50-150 ml free from colloidal or particulate material while minimizing changes in concentrations of dissolved ions as a result of sampling. The method is based upon the burial and subsequent retrieval (after equilibration) of cells made from dialysis membrane filled with deionized water. Field investigations of concentrations of dissolved iron and sulfide in the pore water of base-rich mires were made using this method. The dialysis cell method is simple and cheap. The filled cells are surprisingly robust and amenable to handling in field conditions. It seems probable that the method could be of considerable value in investigating pore water composition in anaerobic wetland substrata. (Moore-IVI)
W86-00511

PHOTOSYNTHESIS AND PRIMARY PRODUCTION OF MICROCYSTIS AERUGINOSA KUTZ. IN LAKE KASUMIGAURA,

National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
N. Takamura, T. Iwakuma, and M. Yasuno.
Journal of Plankton Research, Vol. 7, No. 3, p 303-312, 1985. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Photosynthesis, *Primary productivity, *Microcystis, *Lake Kasumigaura, *Japan, Solar radiation, Water temperature, Cyanophyta, Algae.

Seasonal changes in the photosynthesis and primary production of Microcystis aeruginosa Kutz. were investigated in Lake Kasumigaura (Japan) during 1981-1982. Microcystis always showed a light-saturated photosynthesis-light curve. Both Pmax and the initial slope of the photosynthesis-light curve of Microcystis in early summer were very high, so it was concluded that Microcystis utilized both low and high intensities efficiently. The Pmax of Microcystis was found to be a function of the water temperature except in August and September. The linear regression on the temperature-Pmax relationship discontinued at 11 C, where the Pmax value dropped; Microcystis did not photosynthesize below 4 C. The initial slope of the curve was also descending below 11 C. It is suggested that Microcystis changes its physiological properties below 11 C. The highest value of gross production calculated for M. aeruginosa was 5.4 gC/sq m/d in July; the annual gross production was estimated to be 300 gC/sq m/year (i.e., 40% of the total primary production in this lake). (Author's abstract)
W86-00518

LIMNOLOGICAL STUDIES OF WATERFOWL HABITAT IN SOUTH-WESTERN NEW SOUTH WALES. I. WATER CHEMISTRY,

Commonwealth Scientific and Industrial Research Organization, Lyneham (Australia). Div. of Wildlife and Rangelands Research.
S. V. Briggs, M. T. Maher, and S. M. Carpenter.
Australian Journal of Marine and Freshwater Research, Vol. 36, No. 1, p 59-67, 1985. 2 Fig, 2 Tab, 30 Ref.

Descriptors: *Limnology, *Water chemistry, *New South Wales, Lake Merrimajeel, *Murrumbidgil Swamp, Hydrogen ion concentration, Wetlands, Water level, Dissolved oxygen, Sodium, Potassium, Calcium, Chlorides, Nitrates, Phosphates.

Field investigations were undertaken at two wetlands near Booligal in southwestern New South Wales, which are typical of many in inland southeastern Australia. Murrumbidgil Swamp is approximately circular with a diameter of 1000 m. It is dominated by river red gum and supported a variety of submerged and floating vegetation. Lake Merrimajeel is an elliptical depression, approximately 750 m by 1500 m, with scattered shrubs of lignum and a dense submerged aquatic vegetation. Lake Merrimajeel is filled via a natural channel from Murrumbidgil Swamp. Water chemistry in the two impermanent wetlands was studied as part of a larger investigation into the relationship between water level rises and waterfowl breeding in such wetlands. Except for pH and oxygen, the wetlands were chemically similar, as would be expected because they are connected. Sodium, potassium, calcium and chloride concentrations, conductivity and pH were inversely related to water level. Total loads of iron, phosphate, nitrate and sulfate increased as the wetlands flooded during wetting phases. Nitrate and phosphate levels in experimental tanks also peaked after flooding. The high nutrient levels in freshly flooded wetlands and tanks suggest that release of nutrients from dry soil following reflooding occurred in Murrumbidgil Swamp and Lake Merrimajeel. (Moore-IVI)
W86-00522

PHYTOPLANKTON OF THE LA TROBE RIVER, VICTORIA,

Latrobe Valley Water and Sewage Board, Traralgon (Australia).
B. C. Chessman.
Australian Journal of Marine and Freshwater Research, Vol. 36, No. 1, p 115-22, 1985. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Phytoplankton, *La Trobe River, *Victoria, Chlorophyll a, Algae, Diatoms, Spatial distribution, Lake Narracan, Eutrophication, Seasonal variation, Flow discharge.

The La Trobe River is one of the largest streams of southeastern Victoria, rising about 75 km east of Melbourne and flowing to Lake Wellington, at the western extremeity of the Gippsland Lakes. Phytoplankton was sampled on a monthly basis for 1 year at five stations on the La Trobe River. In the upper, mostly forested, reaches of the river, chlorophyll a concentrations and cell densities were uniformly very low, and the dominant algae were detached benthic diatoms and flagellated species. In the plains section of the river, downstream of an impoundment (Lake Narracan), spring and autumn blooms occurred, with a marked reduction in abundance in midsummer and midwinter. Most true phytoplankters were observed only in Lake Narracan and stations downstream. The lowland planktonic flora was dominanted by centric diatoms, particularly Melosira distans in autumn and Skeletonema potamos in spring. Attempts to relate the seasonal changes in phytoplankton populations of the lower La Trobe the hydrographic, temperature, and nutrient concentration data from routine river monitoring were not entirely successful. The marked increase in populations in October and decline in June did coincide closely with a respective decrease and increase in river discharge at these times. (Moore-IVI)
W86-00523

IN SITU MEASUREMENTS OF UPTAKE OF INORGANIC CARBON AND NITROGEN BY THE AQUATIC LIVERWORTS JUNGERMANNIA VULCANICOLA STEPH. AND SCAPANIA UNDULATA (L.) DUM. IN AN ACID STREAM, KASHIRANASHIGAWA, JAPAN,

Tsukuba Univ. (Japan). Inst. of Biological Sciences.

T. Miyazaki, and K. Satake.
Hydrobiologia, Vol. 124, No. 1, p 29-34, May, 1985. 5 Tab, 27 Ref.

Descriptors: *Liverworts, *Carbon, *Nitrogen, *Acid streams, *Kashiranashigawa, *Japan, Aquatic plants, Solar radiation, Nitrates, Ammonium, Nutrients.

In situ uptake of inorganic carbon and nitrogen by the aquatic liverworts Jungermannia vulcanicola Steph. and Scapania undulata (L.) Dum. was measured in an acid stream, Kashiranashigawa, Japan. The uptake activities were similar in the both species. The activities were highest at the tip of shoots, and decreased gradually towards the base. Carbon uptake at the tip in the light was 0.00104 for J. vulcanicola and 0.00082 g C/g dry wt/h for S. undulata. Ammonium was effectively incorporated into the shoots, and the uptake activity at the tip was between 0.000019 and 0.000058 g N/g dry wt/h. Nitrate uptake was smaller than ammonium uptake. The ratio of dark to light uptake in ammonium uptake experiments was larger than that in carbon uptake experiments. These results suggest that the liverworts use ammonium as a major nitrogen source, and that ammonium uptake was less dependent on light than carbon uptake. (Author's abstract)
W86-00529

LANDSAT STUDY OF THE AQUATIC VEGETATION OF THE LAKE LUODONJARVI RESERVOIR, WESTERN FINLAND,

Oulu Univ. (Finland). Dept. of Astronomy.
J. Raitala, and J. Lampinen.
Aquatic Botany, Vol. 21, No. 4, p 325-346, April, 1985. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Satellite technology, *Aquatic plants, *Lake Luodonjarvi, *Finland, Remote sensing, Reservoirs, Mapping, Spectral reflectance.

Lake Luodonjarvi (Finland) is situated on the Gulf of Bothnia coast and was formed by the damming of what was formerly a brackish-water sea-bay in 1962. The lake area has been effectively overgrown in places. The Loudonjarvi and Ojanjarvi open water areas were studied using Landsat MSS imagery which consists of 4 spectral bands and allows different surface units with characteristic spectral reflectances to be identified down to the minimum resolution (0.5 ha). Spectral differences were detected between different water areas. Seventeen aquatic complexes or types were classified separately on the basis of changes in water characteristics and depth, bottom quality and vegetational succession. The vegetation in summer 1983 was recorded in this way and reviewed against previous mappings in order to illustrate the multitemporal aspects of Landsat studies. The analysis of Landsat MSS data values and associated ground verification data provides a useful map of the extent and location of the overgrown portion of the lake and environmental changes within the area, and can be used to predict the direction of succession trends which are controlled by local conditions. (Moore-IVI)
W86-00532

RECORDING ECHO SOUNDER FOR ASSESSING SUBMERGED AQUATIC PLANT POPULATIONS IN SHALLOW LAKES,

Agricultural and Food Research Council, Oxford (England). Weed Research Organization.
For primary bibliographic entry see Field 7B.
W86-00533

FRESHWATER NAIAD (MUSSEL) FAUNA OF THE NOLIN RIVER IN THE GREEN RIVER DRAINAGE OF CENTRAL KENTUCKY (MOLLUSCA: BIVALVIA),

Marshall Univ., Huntington, WV. Dept. of Biological Sciences.
R. W. Taylor.
Nautilus, Vol. 97, No. 3, p 109-112, July, 1983. 4 Ref.

Descriptors: *Mussels, *Nolin River, *Kentucky, Clams, Endangered species, Distribution, Green River Drainage.

A survey of the freshwater mussels (naiads) of Nolin River of the Green River, Kentucky, drainage, produced specimens of twenty-one species of naiads, and the Asian Clam, Corbicula fluminea. Six of the species reported from the Nolin are considered Endangered or of Special Concern by the Kentucky Academy of Science. Villosa ortmanni is considered endangered by most malacologists because it is restricted in distribution to the Green River drainage. At present, however, it is the most commonly found species in the Nolin River. (Author's abstract)
W86-00534

UNIONIDS (BIVALVIA) OF LOCH RAVEN RESERVOIR, MARYLAND,

P.O. Box 144878 Coral Gables, FL 33114.
G. A. Long.
Nautilus, Vol. 97, No. 3, p 114-116, July, 1983. 1 Fig.

Descriptors: *Mussels, *Loch Raven Reservoir, *Maryland, Water levels, Water currents, Distribution, Behavior.

A 6-yr informal study of mussels in Loch Raven Reservoir, Maryland (USA), yielded 600 specimens, all of which belonged to three species: Anodonta cataracta Say 1817, Lampsilis radiata radiata (Gmelin 1791), and A. imbecillis Say 1982. Four sites were collected: (1) Deadman's Cove, the main channel of Gunpowder Falls, south of Dulaney Valley Road bridge, east of Warren Bridge, and at the Fishing Center. A. cataracta cataracta represented 75% of the shells collected, and was found in quantity at all sites. L. radiata radiata specimens were second in abundance, and A. imbecillis was third, being found at two sites in a growth series that suggested a viable, self-sustaining population. Ninety percent of the specimens of all the taxa collected were dead, having recently expired due to receding water levels. The two species of Anodonta were very active in the substrate, particularly as water levels were reduced, and their directions of movement suggested that as water levels reached less than 0.5 m, the animals were deliberately seeking deeper water. All Lampsilis specimens were found on a substrate normally submerged under deeper water than that in which the bulk of the Anodonta specimens were found (no less than 2 m). All Lampsilis specimens were found at the edge of the swiftest available current in the collection area. Overall, more than 60% of the Lampsilis specimens were found at the Dulaney Valley Road bridge site, where the current is the strongest and most consistent of the entire impoundment. (Rochester-IVI)
W86-00535

LIMNOLOGICAL STUDIES OF RASHDIYAH RESERVOIR, BAGHDAD, IRAQ,

Biological Research Center, Baghdad (Iraq). Dept. of Zoological Sciences.
A. N. Khalaf, A. K. M. S. Islam, M. S.
Mohammed, and A. R. Al-Jafery.
Journal of Biological Sciences, Vol. 14, No. 1, p 25-45, 1983. 9 Fig, 9 Ref.

Descriptors: *Limnology, *Rashdiyah Reservoir, *Iraq, Reservoirs, Water temperature, Solar radiation, Rainfall, Dissolved oxygen, Carbon dioxide, Alkalinity, Salinity, Calcium, Magnesium, Sulfates, Bicarbonates, Phytoplankton.

The physical, chemical and biological conditions of Rashdiyah reservoir (Iraq) were investigated between December, 1979 and November, 1980. Water temperature varied between the depths of a station as well as among the stations on a given sampling date. Duration of sunshine was highest in August and lowest in January and February. Relative humidity was highest in December, January and February and lowest in September. Average rainfall was the highest in February and there was no rainfall at all from May to October. Dissolved oxygen was highest in January and lowest in August. Free carbon dioxide was highest in July and lowest in January. The water of the reservoir were slightly alkaline throughout the period of study. The periods of higher temperatures were accompanied by higher concentrations of salinity. Calcium and magnesium among the cations and sulfate and bicarbonate among the anions dominated during the investigation. The nutrients under consideration showed two peaks one in March and a second one in November. Phytoplankton population showed two maxima one in March and a second one in November. Attempts were also made to correlate the influence of the physicochemical factors upon the growing condition of phytoplankton in the reservoir. (Author's abstract)
W86-00536

CONTRIBUTION TO THE APPLICATION OF THE REGRESSION ANALYSIS IN CONNECTION WITH THE ESTIMATION OF THE PRIMARY PRODUCTION IN THE GROSSER MUGGELSEE (BERLIN) FOR THE PERIOD OF 1979-1982 (EIN BEITRAG ZUR ANWENDUNG DER REGRESSIONSANALYSE IM ZUSAMMENHANG MIT DER SCHATZUNG DER PRIMARPRODUKTION IM GROSSEN MUGGELSEE (BERLIN) FUR DEN ZEITRAUM 1979...1982),

Akademie der Wissenschaften der DDR, Berlin. Inst. fuer Geographie und Geooekologie.
R. Stellmacher, and B. Nixdorf.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 6, p 653-657, 1984. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Muggelsee, *Germany (Democratic Republic), *Primary productivity, Regression analysis, Water quality, Statistical methods, Mathematical studies.

The lake Muggelsee (German Democratic Republic), which is important for the drinking water supply of Berlin, has been thoroughly investigated for some years with respect to its quality state and conversion of substances. To reduce working time and material expense for measuring of the primary production, various mathematical-statistical possibilities are checked with the aid of the results of series of investigations which have been performed for years. Of the calculating methods studied, the linear regression through the origin and the exponential approach provided the best approximation of measured and calculated results of the surface integral of the primary production as estimated from the production value of the optimum horizon for the Muggelsee type of lake. (Author's abstract)
W86-00551

VARIATION OF CHEMICAL PARAMETERS IN THE DEPTH PROFILE OF THE RIVER CHAMPANALA,

S.M. Coll., Bhagalpur (India). Dept. of Zoology.
R. Hasan.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 6, p 679-683, 1984. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Champanala, *India, *Chemical properties, *Water depth, Stratification, Velocity, Flow discharge, River flow, Water temperature, Alkalinity, Dissolved oxygen, Carbon dioxide, Hydrogen ion concentration.

The River Champanala (India), which derives its flow from the Ganges during flood, and reenters the Ganges after about 20 km, exhibited a temporary chemocline in late October, 1978, when sampling of a profile at about 0.5 km upstream from its confluence with the Ganges was conducted. At that time, the mean velocity of flow was 2.75 m/sec, and the discharge was 546 cu m/sec (based on linear interpolation from sampling done at other times); the depth of the river at the time of sampling was 1.68 m. Temperature declined gradually from the surface (29.0 C) to 0.76 m (28.0 C), and then declined to 27.8 C at 1.37 m, being the same at the bottom. Carbonate alkalinity was nil throughout the profile, CaCO3 was 148.0 ppm throughout the profile, dissolved oxygen declined from 9.5 ppm at the surface to 9.3 ppm at 0.76 m, and then to 6.4 ppm at the bottom. Free carbon dioxide was 2.2 ppm at the surface, 4.5 ppm at 0.76 m, and 1.8 ppm at 1.07 m, and only 1.5 ppm at the bottom. pH was 8.0 from the surface to 0.76 m, declining to 7.6 at the bottom. High photosynthetic activities probably account for the dissolved oxygen profile, whereas the C02 profile may be accounted for by

the shallow depth of flow and comparatively high velocity of flow, as well as high respiration. (Rochester-IVI)
W86-00552

STUDIES ON RIVERINE ECOLOGY OF TORRENTIAL WATERS IN THE UPLANDS OF THE GARHWAL REGION, II. SEASONAL FLUCTUATIONS IN DIATOM DENSITY,

Garhwal Univ., Srinagar (India). Dept. of Zoology.
P. Nautiyal.
Proceedings of the Indian Academy of Sciences (Animal Sciences), Vol. 93, No. 7, p 671-674, December, 1984. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Diatoms, *Seasonal variation, *Streams, *Garhwal, *India, Alaknanda, Nayar, Water temperature, Silt, Monsoons, Water currents.

Seasonal fluctuations along with certain physicochemical parameters were recorded for two hillstreams, the Alaknanda (snow-fed) and the Nayar (spring-fed) in the Garhwal Region (India), In the former, the water temperature range of 9-14 C is considered optimum for the growth of diatoms, compared to 12-21 C in the Nayar. In both hillstreams diatoms achieved their maxima during January, when the water temperature is the lowest. Sudden influx of rain water carrying enormous silt during monsoon is responsible for the decline in density. The water temperature and current, especially the latter is thus a detrimental factor. The interesting feature of the study is, the relatively higher percentage of diatoms in the Nayar than in the Alaknanda, obviously to be attributed to the warm waters in the former. (Author's abstract)
W86-00576

SEASONAL VARIATION IN PRIMARY PRODUCTION IN RELATION TO SOME LIMNOLOGICAL FEATURES IN LAKHOTIA LAKE (INDIA),

Jodhpur Univ. (India). Dept. of Zoology.
T. C. Khatri.
Proceedings of the Indian Academy of Sciences (Animal Sciences), Vol. 93, No. 7, p 697-702, December, 1984. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Limnology, *Primary productivity, *Lakhotia, *India, Lakes, Seasonal variation, Chlorophyll a, Water temperature, Alkalinity, Monsoons.

Lakhotia is a man-made, rain-fed, perennial lake in Pali city, in the semiarid region of Rajasthan, India. The primary production of the lake was determined and compared with other tropical and temperate water bodies. The annual gross production in Lakhotia was 1956.035 gC/sq m. The maximum gross primary production was recorded during summer when there was an increase in water temperature, chlorophyll-a and alkalinity. After attaining a peak in June, the alkalinity declined sharply during monsoon and consequent flood, and in winter it increased again. High production was observed when temperatures ranged from 27-33 C. The difference between gross and net primary production was wide, the percentage of respiration in gross production being 15.6-100. Primary production in Lakbotia is moderate. Chlorophyll-a and water temperature act as favorable factors, whereas transparency and alkalinity are limiting factors. (Moore-IVI)
W86-00578

PROBABILITY-OF-USE FOR DEPTH, VELOCITY, AND SUBSTRATE BY SUBYEARLING COHO SALMON AND STEELHEAD IN LAKE ONTARIO TRIBUTARY STREAMS,

New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
J. D. Sheppard, and J. H. Johnson.
North American Journal of Fisheries Management, Vol. 5, No. 2B, p 277-282, Spring, 1985. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Salmon, *Water depth, *Velocity, *Substrates, *Streams, New York, Lake Ontario tributaries, Coho, Steelhead, Habitats, Streamflow, Seasonal variation.

Probability-of-use information for depth, velocity, and substrate by subyearling coho salmon (Oncorhynchus kisutch) and steelhead (Salmo gairdneri) in three New York tributaries of Lake Ontario was obtained during June and October in 1980. In June, coho salmon occurred predominantly in areas with mean velocities of 0.30-0.70 ft/second and at depths of 2.00-2.40 ft, whereas steelhead occupied habitats with mean velocities of 0.40-0.80 ft/second and depths of 0.30-0.50 ft. In October, subyearling coho salmon were found in areas with mean velocities of 0.00-0.30 ft/second and at depths of 1.50-2.80 ft while steelhead occurred at depths of 0.60-1.20 ft where mean velocities were 0.10-0.80 ft/second. Subyearling coho salmon occurred over gravel-cobble substrates during both seasons, whereas steelhead were found in areas with substrate material of larger sizes in the autumn. Observed seasonal differences in the habitat and flow preferences of both species were completely masked when the data were pooled to yield a single estimate for depth and mean velocity. Variations in the probability-of-use for these habitat parameters may be related to seasonal differences in fish size and the physical characteristics of the streams. (Author's abstract)
W86-00590

WHOLE-LAKE FERTILIZATION EXPERIMENTS IN COASTAL BRITISH COLUMBIA LAKES: EMPIRICAL RELATIONSHIPS BETWEEN NUTRIENT INPUTS AND PHYTOPLANKTON BIOMASS AND PRODUCTION,

Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
For primary bibliographic entry see Field 5C.
W86-00603

DEPTH DISTRIBUTION AND BIOMASS OF SUBMERSED AQUATIC MACROPHYTE COMMUNITIES IN RELATION TO SECCHI DEPTH,

McGill Univ., Montreal (Quebec). Dept. of Biology.
P. A. Chambers, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 701-709, April, 1985. 6 Fig, 5 Tab, 38 Ref.

Descriptors: *Water depth, *Macrophytes, *Biomass, *Opacity, Aquatic plants, Submerged plants, Eutrophication, Solar radiation, Charophytes, Angiosperms, Bryophytes, Water temperature, Lakes, Trophic levels, Nutrients, Wave action, Substrate, Water currents.

Increased nutrient loading into many lakes during the past yr has led to pronounced changes in both the depth distribution and standing crop of submerged aquatic plants. Although changes in the growth of aquatic macrophyte communities are clearly correlated with lake eutrophication, it is not known how much macrophyte biomass will increase or how much the depth of macrophyte colonization will shift in response to changes in lake trophy. Regression models were developed that allow prediction of the maximum depth of macrophyte colonization for angiosperms, bryophytes, and charophytes and the depth of maximum angiosperm biomass from mean summer Secchi depth. Irradiance over the growing season at the maximum depth of colonization was about 1800 L/sq cm (1 cal/sq cm = 0.239 J/sq cm) for angiosperms and bryophytes and 1200 J/sq cm for charophytes. These values represent, on average, 21 and 11% of the photosynthetically available radiation incident on the water surface. Changes in maximum angiosperm biomass were not correlated with Secchi depth. The depth distribution of aquatic macrophyte communities is primarily controlled by irradiance, but environmental parameters other than irradiance and nutrients are also important in determining maximum angiosperm biomass in individual lakes. Such environmental factors include wave action, currents, substrate particle size and stability, and temperature. (Moore-IVI)
W86-00606

POSTSETTLEMENT DIATOM SUCCESSION IN THE BAY OF QUINTE, LAKE ONTARIO,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W86-00609

NITROGEN, PHOSPHORUS, AND ORGANIC CARBON CYCLING IN AN ARCTIC LAKE,

Alaska Univ., Fairbanks. Inst. of Marine Science.
S. C. Whalen, and J. C. Cornwell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 797-808, April, 1985. 9 Fig, 5 Tab, 41 Ref. NSF grants DPP79-00815 and DPP77-23475.

Descriptors: *Nitrogen, *Phosphorus, *Organic carbon, *Toolik Lake, *Alaska, Cycling nutrient, Arctic lakes, Water temperature, Lake sediments, Primary productivity.

Budgets for nitrogen, phosphorus, and organic carbon in Toolik Lake, Alaska, were assembled from data collected during 1977-81. The annual total organic carbon (TOC), total nitrogen (TN), and total phosphorus (TP) loads to the lake were 8557, 290, and 4.64 mmol/sq m. Inlet streams were the major source of nutrients to the lake, as direct precipitation provided only 1, 2, and 5%, respectively, of the annual TOC, TN, TP loads to the lake. Up to 30% of the annual N and P inputs to the lake from riverine sources occurred during the first 10 d of stream flow following breakup when cold water temperatures and snow-covered ice limited primary production. Due to the short water renewal time (0.5 yr), efficiency of nutrient retention was poor and 90, 82, and 70% of the annual TOC, TN, and TP inputs to the lake were discharged at the outlet stream. Regeneration within the water column supplied 40-66% and 68-78% of the N and P necessary for measured primary production. Yearly accumulation rates for C, N, and P in the sediment were about 220, 21.0 and 1.75 mmol/sq m. Phosphorus remineralized within the sediment was completely retained due to adsorption onto Fe oxide minerals in the oxidizing surface layer. Annual rates of release of C and N to the overlying water column were 110 and 11.5-22.2 mmol/sq m. Mass balance considerations showed no serious errors in estimates of any terms of the annual sediment and water column N, P, and organic C budgets. (Author's abstract)
W86-00611

SEDIMENT ACCUMULATION RATES IN AN ALASKAN ARCTIC LAKE USING A MODIFIED 210PB TECHNIQUE,

Alaska Univ., Fairbanks. Inst. of Marine Science.
J. C. Cornwell.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 809-814, April, 1985. 5 Fig, 1 Tab, 22 Ref. NSF grant DPP77-23475.

Descriptors: *Sediment accumulation, *Lead radioisotopes, *Toolik Lake, *Alaska, Arctic lakes, Manganese, Iron, Aluminum, Lake sediments.

Toolik Lake is located in the northern foothills of the Brooks Range, Alaska. Its watershed coverrs 65 sq km, while the lake covers 1.5 sq km. The lake is ice covered from late September to late June. Because of high concentrations of authigenic Mn and Fe oxides in surficial sediments from Toolik Lake, the normalization of depth and Pb-210 activity scales to the sediment Al content was used for sediment accumulation rate calculations; results are compared with the conventional Pb-210 dating technique. The flux of Pb-210 to the lake was very low (10 dpm/sq cm/yr), and excess Pb-210 is restricted to the top 5 cm of sediment. The whole lake sediment accumulation rate is about 2.7 mg/sq cm/yr and the sediments are little disturbed by physical or biological processes. Low rates of physical and chemical weathering are responsible for the low sediment accumulation rates. The short period of runoff, low annual rates of rainfall, and stabilization of soils by tundra vegetation result in low exports of particulate material to Toolik Lake. (Moore-IVI)
W86-00612

CRITIQUE OF THE INSTREAM FLOW INCREMENTAL METHODOLOGY,

Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab.
D. Mathur, W. H. Bason, E. J. Purdy, Jr., and C. A. Silver.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 825-831, April, 1985. 4 Fig, 1 Tab, 10 Ref.

Descriptors: *Instream Flow Incremental Methodology, *Habitat, *Fish populations, Biomass, Fish behavior, Ecological distribution, Reviews.

A review and reanalysis of the published literature show that several assumptions are violated in the application of the Instream Flow Incremental Methodology (IFIM) without consideration of the implications of so doing. The fundamental assumption of a positive linear relationship between 'potential available habitat' (WUA) and biomass of fish has neither been documented nor validated, particularly in warmwater streams. Absence of correlation precludes prediction of changes in fish populations. In some studies the test of this assumption appears to be equivalent to a calibration operation. The other assumption violated includes independent selection of habitat variables by fish. The presence of significant interaction among habitat variables can affect the stream flow recommendations. Another problem exists in application of Physical Habitat Simulation (PHABSIM); one WUA unit should not be interpreted as being equal to another in biological production or habitat value unless shown to be an exact replica. Several combinations of physical variables could give rise to the same amount of WUA, none of which may be correlated to the biomass of fish. The utilization, suitability, or preference curves should not be treated as probability functions; a rating of 1.0 is not equivalent to probability of 1.0. Care should be taken to distinguish between real behavioral preferences of fishes based on distributional occurrence from abundance (relative or absolute size) in a steam. (Author's abstract)
W86-00613

2I. Water In Plants

TABLES FOR ESTIMATING DAILY EVAPORATION RATES OVER CROPS USING TEMPERATURE, ELEVATIONAL AND LATITUDINAL DATA ONLY,

Cedara Research Inst., Pietermaritzburg (South Africa).
B. Clemence.
Report N 5/1982. 45 p, 1 Tab, 2 Append.

Descriptors: *Evapotranspiration, *Soil water, *Elevation, *Agricultural hydrology, *Irrigation, *Data collections, Natal, South Africa, Altitude, Climatic data, Hydrologic data collections, Temperature, Crop factor, Rainfall, Precipitation, Wind velocity.

Tables for estimating evaporation over crops using Linacre's method are given for a variety of climates between latitudes of 27-31 degrees south in South Africa. Factors considered are elevation, temperature statistics, and climate type. Wind speed may be incorporated if known. This is important in coastal areas. Crop factors (the ratio between potential evapotranspiration and evaporation from Class A pans) are given.
W86-00313

GROWTH AND WATER USE OF TALL FESCUE AS INFLUENCED BY SEVERAL SOIL DRYING CYCLES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
M. J. King, and L. P. Bush.
Agronomy Journal, Vol. 77, No. 1, p 1-4, January-February, 1985. 5 Fig, 21 Ref.

Descriptors: *Plant growth, *Water use, *Fescue, *Soil water, Water stress, Watering schedule, Water potential, Osmotic potential, Turgor.

Many investigations have studied various physiological processes using plants watered on a schedule with the effect of this watering schedule seldom considered significant. An understanding of the effect of watering frequency on growth and water use is required to understand water stress tolerance of tall fescue (Festuca arundinacea Schreb.). Experiments were designed to evaluate the effect of the watering schedule in greenhouse grown tall fescue on growth, water use, and meristem tissue water status. Growth and water use as well as water, osmotic, and turgor potential of the leaf meristematic region were measured on tall fescue seedlings that had been exposed to several Maury soil (a fine, mixed, mesic Typic Paleudalfs) drying cycles (stressed and daily watered). Growth, measured as leaf extension rate (LER), was greater for seedlings watered to field capacity every 4th day than daily watered seedlings when soil of both treatments was allowed to dry. No significant difference in water potential or osmotic potential was observed during the experiment, and the differential LER was not dependent on turgor potential of the meristematic area which was similar to both treatments. Water use was 50 to 100% higher in control seedlings during the first 48 h of a soil drying cycle than in stressed seedlings. After several soil drying cycles the enhanced growth of stressed plants increased as high as 280%, then declined over the next 24 days of daily watering to about 50% above the control. The enhanced LER did not result in greater shoot fresh weights, but, repeated soil drying depressed root development. Consequently, growth, water status, and water use by tall fescue plants during an experiment must be evaluated in terms of the plants prior water stress history. (Author's abstract)
W86-00459

ROW SPACING, PLANT POPULATION, AND WATER MANAGEMENT EFFECTS ON CORN IN THE ATLANTIC COASTAL PLAIN,

Agricultural Research Service, Florence, SC.
For primary bibliographic entry see Field 3F.
W86-00460

PHYSIOLOGICAL RESPONSE OF MEADOWFOAM TO CROP WATER DEFICITS,

Colorado State Univ., Grand Junction. Fruita Research Center.
For primary bibliographic entry see Field 3F.
W86-00461

SOYPHEN: SOYBEAN GROWTH STAGES MODELED FROM TEMPERATURE, DAYLENGTH, AND WATER AVAILABILITY,

Missouri Univ.-Columbia. Dept. of Atmospheric Science.
T. Hodges, and V. French.
Agronomy Journal, Vol. 77, No. 3, p 500-505, May-June, 1985. 6 Fig, 6 Tab, 23 Ref. NOAA grant NA-82-AA-H-00011.

Descriptors: *Soybeans, *Model studies, *Plant growth, *Daylength, *Air temperature, *Water availability, Water stress, Computers, Phenology, Climate, Rainfall.

The soybean plant (Glycine max L.) responds strongly to daylength and temperature in it phasic development. Daylength responses vary greatly between varieties. Under very dry conditions, water stress may also affect development. Attempts to develop physiologically based large area yield models for soybeans have been hampered by the lack of a growth stage model incorporating these responses and applicable to a wide geographic and climatic range. The objective of this work was to develop a physiologically based model to predict growth stage dates for soybeans for the widest possible range of maturity groups and geographic areas. A phenology model was developed and tested for soybean Maturity Groups I to V based on temperature, daylength, and water availability. Coefficients were also developed, but not tested independently for Maturity Groups 00, 0, and VI to IX. Coefficients for Maturity Groups I to V were developed from 3 years (1971 to 1973) of data with five planting dates per year collected at Columbia, MO. The coefficients were tested on data sets taken at the same time at Spickard and Mt. Vernon, MO and on data for the 1981 season from 22 international sites. The test results indicate that the model will generate reliable estimates of soybean growth stages over a wide range of climatic conditions. The coefficients for Maturity Groups 00, 0, and VI to IX were developed from data from international sites, but no data were available for independent testing. The model is available in the FORTRAN and PL/I programming languages. It is suitable for incorporation into a soybean growth simulation model or for running as an independent crop calendar model. The model may be run wherever daily maximum and minimum temperatures and rainfall are available. (Author's abstract)
W86-00462

NITROGEN- AND WATER-USE EFFICIENCY OF SEVERAL COOL-SEASON GRASSES RECEIVING AMMONIUM NITRATE FOR 9 YEARS,

Nebraska Univ.-Lincoln.
J. F. Power.
Agronomy Journal, Vol. 77, No. 2, p 189-192, March-April, 1984. 1 Fig, 7 Tab, 11 Ref.

Descriptors: *Water-use efficiency, *Ammonium nitrate, *Grasses, Fertilizers, Plant growth, Nitrogen, Root growth, Drought, Water use.

Comparative information is needed on differences between grass species regarding dry matter production, root growth, water use, and response to N fertilization, as affected by both age of stand or years of N fertilization. The research reported was conducted on a Temvik silt loam (fine-silty, frigid, mixed Typic Haploboroll) at Mandan, ND. Ammonium nitrate was surface broadcast at 0, 45, or 225 kg N/ha for 9 years on established stands of western wheatgrass (Pascopyrum smithii Rydb.(Love)), crested wheatgrass (Agropyron desertorum (Fish. ex Link) Schult.), intermediate wheatgrass (Elytrigia intermedia (Host) Nevski), smooth bromegrass (Bromus inermis Leyss.), Russian wildrye (Psathyrostachys juncea (Fisch.) Nevski), green needlegrass (Stipa viridula Trin.), and Garrison creeping foxtail (Alopecurus arundinaceus Poir). Dry matter production was usually greatest for E. intermedia. Production for B. inermis, P. smithii, and A. desertorum averaged 85 to 90% that of E. intermedia, and about 65 to 72% for the other species. Dry matter production for all species was generally doubled by 45 kg N/ha, and increased three-to fourfold with 225 kg N/ha. At 45 kg N/ha, N-use efficiency varied from an average of 51 kg dry matter per kg N for E. intermedia to 22 for Ps. juncea. Corresponding values at 225 kg N/ha dropped to 16 and 12 kg/kg N. Root dry weights were generally increased 50 to 100% by both N rates, but consistent differences among species were not evident. Annual water use was increased about 20 mm by fertilization, except in extreme drought years. Water-use efficiency (WUE) was also increased about threefold by fertilization, ranging from 22.6 kg/mm for fertilized E. intermedia to 3.2 for nonfertilized Al. arundinaceus. Water-use efficiency was highly correlated with dry matter production, increasing about 2.8 kg/mm for each 1000 kg/ha increase in production, with no effect of species, time, or N fertilization. (Author's abstract)
W86-00463

RESPONSE OF SELECTED SOYBEAN CULTIVARS TO SOIL MOISTURE DEFICIT,

Missouri Univ.-Columbia.
E. A. Brown, C. E. Caviness, and D. A. Brown.
Agronomy Journal, Vol. 77, No. 2, p 274-278, March-April, 1984. 8 Tab, 15 Ref.

Descriptors: *Water stress, *Water deficit, *Soybeans, Crop yield, Cultivars, Plant growth, Soil water, Irrigation.

Moisture is a major factor limiting yield in most areas where soybeans are grown. Moisture stress experiments were conducted under field conditions using four determinate soybean cultivars of Group VI maturity, in 1980 and 1981 on a Captina silt loam at Fayetteville, AR. The experiments consisted of two moisture stress treatments which were

initiated at the R2 and R4 growth stages and a control which was irrigated as needed throughout the season. Measurements were made on both roots and aboveground plant parts. When a moisture deficit was initiated by placing black plastic over the plots at either R2 or R4, seed yield was significantly reduced both years. A moisture deficit following application of plastic of R2 reduced yield more than at R4 in 1981, but the reverse was found in 1980, an extremely dry year. A moisture deficit initiated at R4 significantly reduced seed size and seed number both years whereas seed size was not significantly reduced either year by deficits initiated at R2. The cultivar Sohoma produced significantly larger seeds than the other three cultivars when plants were moisture stressed at R4. No significant cultivar x moisture stress interactions involving seed yield were observed in either year; however, there was a definite trend for seed yields of Sohoma to be reduced less by moisture deficits initiated at stage R4 in both 1980 and 1981. Percent flower and pod shedding did not appear to be affected to any great extent by the moisture stress treatments in either year. Flower production and shedding apparently are not important factors causing yield reductions under soil water deficits in these experiments. Moisture stress appeared to reduce root density under the row at both growth stages. Soybean cultivars differ to some extent in their response to soil moisture deficits, but these differences generally are small and not consistent in different environments. (Moore-IVI)
W86-00465

RELATIONSHIPS BETWEEN CROP WATER STRESS INDEX AND ALFALFA YIELD AND EVAPOTRANSPIRATION,

New Mexico Agricultural Experiment Station, Las Cruces.
A. S. Abdul-Jabbar, D. G. Lugg, T. W. Sammis, and L. W. Gay.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 454-461, March/April, 1985. 4 Fig, 7 Tab, 24 Ref.

Descriptors: *Evapotranspiration, *Water stress, *Crop yield, *Alfalfa, Evaporation, Transpiration, Water loss, Canopy temperature, Aerodynamic resistance,.

Two methods of determining Crop Water Stress Index (CWSI) were compared for alfalfa. The first method was the graphic method of Idso using the temperature differential between canopy and air. A significant relationship was obtained between evapotranspiration (E) and potential evaporation (Ep). The second method uses energy balance considerations to determine CWSI. Aerodynamic resistance r(a), which is needed to calculate CWSI, was evaluated using three different methods. The wind profile method overestimated r(a) and, accordingly, underestimated CWSI. The CWSI estimated using this method was not well correlated with measured E/Ep or dry forage yield. Overall, the CWSI concept provided a good indicator of alfalfa evapotranspiration and yield, and has potential to be used in irrigation scheduling. Values of CWSI can be determined rapidly using an infrared thermometer or using meteorological data. (Baker-IVI)
W86-00468

TRANSPIRATION RATE AND WATER USE EFFICIENCY OF SOYBEAN LEAVES ADAPTED TO DIFFERENT CO2 ENVIRONMENTS,

Florida Univ., Gainesville. Dept. of Agronomy.
For primary bibliographic entry see Field 2D.
W86-00483

RESPONSES OF C4 GRASSES TO ATMOSPHERIC CO2 ENRICHMENT. II. EFFECT OF WATER STRESS,

Duke Univ., Durham, NC. Dept. of Botany.
N. Sionit, and D. T. Patterson.
Crop Science, Vol. 25, No. 3, p 533-537, May/June, 1985. 4 Fig, 26 Ref. NSF grants DEB78-23640 and DEB80-21312.

Descriptors: *Water stress, *Grasses, *Carbon dioxide, Conductance, Photosynthesis, Stomatal transpiration, Leaves, Water potentials.

Water relationships and photosynthetic and stomatal responses of four different species of C4 grasses to increases in atmospheric CO2 concentration under water stress conditions were studied. Water and osmotic potentials of the leaves of the plants grown at both CO2 levels declined slowly for 3 to 6 days after watering ceased, then declined more rapidly toward the end of the stress period. The rate of decline in leaf water potential and the minimum values reached at the end of the stress cycle differed among the species. Leaf water potentials of the plants grown at the high CO2 concentration declined more slowly and maintained higher values at the end of the stress period than those of plants grown at low CO2 concentration. Osmotic potentials also declined more in the leaves of plants grown at low CO2 than in those grown at high CO2. Plants grown at high CO2 maintained a more positive turgor pressure at the end of the stress cycle than the plants grown at low CO2 concentration. The minimum leaf turgor pressure attained during water stress in these studies varied among species and was different at different CO2 concentrations. Wilting was observed only in one species grown at 350 micromol/mol CO2. High CO2-grown plants had greater net photosynthetic rates than low CO2-grown plants prior to water stress. There is presumably an adaptive advantage to high CO2-grown plants in maintaining higher leaf water potential under water stress conditions. Under the conditions of water stress, the stomata of the four C4 species grown in high CO2 do not change significantly but the leaves maintain greater turgor and higher net photosynthetic rates compared to those of the low CO2-grown plants. (Baker-IVI)
W86-00484

POTENTIAL FOR USING LEAF TURGIDITY TO SELECT DROUGHT TOLERANCE IN COTTON,

Agricultural Research Service, Lubbock, TX. Plant Stress and Water Conservation Research Unit.
J. E. Quisenberry, C. W. Wendt, J. D. Berlin, and B. L. McMichael.
Crop Science, Vol. 25, No. 2, p 294-299, March/April, 1985. 2 Fig, 5 Tab, 17 Ref.

Descriptors: *Drought resistance, *Leaves, *Turgidity, *Cotton, Water potential, Water stress, Photosynthesis, Water use efficiency, Biomass, Conductance, Wilting.

A comparison was made of growth rates, physiological responses, and seed cotton yield under water stressed field conditions between cotton strains that differed in ability to maintain leaf turgidity under dry field conditions. The observed variability in leaf turgidity among cotton germplasm is potentially useful in the development of drought tolerant germplasm. The nonflowering, nonwilting T25 strain produced more shoot biomass than did the nonflowing, wilting T169 strain under water deficit field conditions, and under glass house conditions, T25 produced more biomass per unit of transpired water than did T169. When genes for the day-neutral flowering response from Lubbock Dwarf were introgressed into the two strains, populations and selected lines showed a significant yield advantage for the T25 germplasm over the T169 germplasm under water deficit field conditions. The physiological data suggest that T25 reduces water loss under optimal water conditions through reduced leaf conductances which allows T25 to use this saved water to keep its stomata partially open longer and thus fix C and grow longer when seasonal soil water is limited. (Baker-IVI)
W86-00486

COMPARATIVE EFFECTS OF REPEATED CYCLES OF WATER STRESS ON GROWTH AND APPARENT DINITROGEN FIXATION OF LADINO AND STRAWBERRY CLOVERS,

California Univ., Davis. Dept. of Agronomy and Range Science.
K. L. Johnson, and C. A. Raguse.
Crop Science, Vol. 25, No. 2, p 299-306, March/April, 1985. 2 Fig, 3 Tab, 32 Ref.

Descriptors: *Water stress, *Plant growth, *Crop yield, Soil water, Drought, Leaves, Water potential, Nitrogen fixation, Temperature effects.

The effects of repeated short-term cycles of soil moisture depletion on canopy temperature, leaf water potential, and nodule hydration as indicators of plant stress were examined. The relationship between repetitive short-term water stress (10 hr visible wilting) and apparent N2 fixation and maintenance of vegetation growth was determined. The response to stress can be generalized in at least three categories. First, responses which result from diurnal, cyclic changes in the environment; second, similar responses which are demonstrated over a period of 2 to several days but are reversible; and third, longer-term responses which are derived from integration of effects of combined and/or repeated short-term influences. Daily variation in the differential between canopy and air temperature provided an example of the first stress response. Short term, cyclic fluctuations in leaf water potential, nodule hydration, and acetylene reduction activity demonstrated the second, and decreases in total plant dry matter and N, as well as decreased accumulation of leaf and stolon growth, exemplified the third. Results of the ladino and straawberry clover experiments suggest that if stress events of moderate (reversible) impact are repeated at close intervals, resultant longer-term reductions in growth can lower above-ground production of stem and leaf tissue by as much as 40% within time periods equivalent to a typical hay production or pasture rotation cycle. (Baker-IVI)
W86-00487

EFFECTS OF N FERTILITY ON PLANT WATER RELATIONS AND STOMATAL RESPONSES TO WATER STRESS IN IRRIGATED COTTON,

Agricultural Research Service, Phoeniz, AZ. Western Cotton Research Lab.
J. W. Radin, J. R. Mauney, and G. Guinn.
Crop Science, Vol. 25, No. 1, p 110-115, January/February, 1985. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Crop yield, *Water stress, *Irrigation practices, *Water use efficiency, *Cotton, Leaves, Water potentials, Stomatal transpiration, Conductance, Osmotic pressure.

The effects of N fertility on water relations and stomatal behavior of irrigated cotton in the field were explored and those effects were compared to effects on yield and water use efficiency (WUE). High levels of N caused stomata to remain open to very low osmotic potentials in irrigated cotton during the early part of the fruiting cycle, but this effect was lost as the season progressed. In July, stomata of high-N plants closed at an osmotic pressure considerably below the wilting point. In September, closure occurred much closer to the wilting point. In low-N plants, stomatal closure was more closely associated with the wilting point throughout the season. The changing stomatal behavior of high-N plants was apparently related to petiole NO3-N levels but not to total leaf N. The effects of low N on plant water relations and water use were such that 10-cm irrigations produced as much yield as, and a higher WUE than, 15 cm irrigations. (Baker-IVI)
W86-00488

SIMULATION OF MOISTURE STRESS EFFECTS ON SOYBEAN YIELD COMPONENTS IN NEBRASKA,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
G. E. Meyer.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 118-128, January/February, 1985. 6 Fig, 7 Tab, 46 Ref.

Descriptors: *Water stress, *Crop yield, *Soybeans, *Nebraska, Simulation, SOYMOD/OARDC, Model studies, Irrigation effects, Plant growth, Overwatering.

The most recent improvements and modifications to the model SOYMOD/OARDC are described

along with explanations of how the model can be used to study water stress interactions with soybeans. A sensitivity study is provided involving different weather sequences to simulate how the soybean crop responds to these conditions. Supplemental water can be applied to an indeterminant soybean crop based on soil moisture depletion during the critical stages of reproductive growth (podfill) to reduce moisture stress during these periods. The simulations suggest that there can be a number of complicating factors for achieving large soybean seed yields with irrigation. Overwatering or large water supply during vegetative stages may elicit competitive response of the leaves for nitrogen with later fruit development which may result in smaller size fruit. Optimization analyses should be applied to determinate soybean irrigation studies to determine when to apply water that will elicit a significant yield response. As the physiological system becomes better quantified, computer simulation will play an important role in these optimization studies. Some of the new features and capabilities of REALSOY have been demonstrated for research and teaching activities. The model is quite flexible and upgradable. It can give fast estimates of soybean seed size and yield or generate a complete analysis of physiological data at the console. (Baker-IVI)
W86-00491

COTTON PLANT RESPONSE TO WIND AND WATER STRESS,

Agricultural Research Service, Lubbock, TX. Cropping Systems Research Service.
G. L. Barker, J. L. Hatfield, and D. F. Wanjura.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 194-200, January-February, 1985. 6 Fig, 4 Tab, 16 Ref.

Descriptors: *Cotton, *Wind, *Water stress, Crop yield, Phenology, Shelter, Water use, Air temperature, Regression equations.

Cotton plant phenology was observed in a sheltered environment for six different planting dates and compared to cotton grown in an unsheltered area. The shelters consisted of a snow fence and provided a 35% reduction in wind velocity 0.2 m above the crop for the season. Increased plant height, earlier squaring, earlier boll set and more bolls and biomass were observed for sheltered cotton when compared to the unsheltered cotton. The unsheltered cotton used less water than the sheltered cotton. Regression equations were developed to predict plant height and the change in plant height as a function of age of the plant, wind movement, daytime temperature and nighttime temperature. (Author's abstract)
W86-00503

WATER USE EFFICIENCY IN A SOYBEAN FIELD: INFLUENCE OF PLANT WATER STRESS,

National Oceanic and Atmospheric Administration, Oak Ridge, TN. Air Resources Atmospheric Turbulence and Diffusion Lab.
D. D. Baldocchi, S. B. Verma, and N. J. Rosenberg.
Agricultural and Forest Meteorology, Vol. 34, No. 1, p 53-65, February, 1985. 6 Fig, 3 Tab, 41 Ref. Regional Research Project 11-33 and Nebraska Agricultural Experimental Station Project 11-049.

Descriptors: *Water use efficiency, *Soybeans, *Water stress, Photosynthesis, Evapotranspiration, Carbon dioxide, Stomatal resistance, Soil water, Plant water potential, Leaves.

Measurements were made in 1980 over a fully-developed soybean (Glycine max (L.) Merrill) canopy at Mead, Nebraska to determine how crop water status influences photosynthesis, evapotranspiration and water use efficiency. Water use efficiency was calculated in terms of the CO2-water flux ratio (CWFR). Micrometeorological techniques were used to measure the exchange rates of CO2 and water vapor above the crop canopy. Crop water status was evaluated by reference to volumetric soil moisture (theta sub v), stomatal resistance (r sub s), and leaf water potential (psi) measurements. Stomatal resistance (r sub s) was independent of psi when the latter was greater than -1.1 MPa; r sub s increased sharply as psi dropped below this threshold. Canopy CO2 exchange (F sub c) decreased logarithmically with increasing r sub s under strong irradiance. Although Fc was found to be strongly correlated with r sub s, the influence of low values of psi and of high air temperature cannot be discounted since these factors affect the enzymatic reactions associated with photosynthesis. Stomatal closure also reduced evapotranspiration and influenced the partitioning of net radiation. Under strong irradiance the CO2 water flux ratio (CWFR) decreased with increasing stomatal resistance. This observation is at variance with predictions of certain early 'resistance' models, but substantiates predictions of some recent models in which leaf energy balance considerations are incorporated. (Author's abstract)
W86-00505

EVALUATING PLANT AND CANOPY RESISTANCES OF FIELD-GROWN WHEAT FROM CONCURRENT DIURNAL OBSERVATIONS OF LEAF WATER POTENTIAL, STOMATAL RESISTANCE, CANOPY TEMPERATURE, AND EVAPOTRANSPIRATION FLUX,

National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
B. J. Choudhury, and S. B. Idso.
Agricultural and Forest Meteorology, Vol. 34, No. 1, p 67-76, February, 1985. 7 Fig, 25 Ref.

Descriptors: *Plant water potential, *Stomatal resistance, *Canopy temperature, *Evapotranspiration, *Wheat, Leaves, Diurnal variation, Soil water, Transpiration, Mathematical equations.

Concurrent observations of leaf water potential, stomatal diffusion resistance and canopy temperature were made on two plots of wheat (Triticum aestivum L. cv. Anza) growing at Phoenix, Arizona under two different soil water conditions. These data were further complemented by weather observations and lysimeter measurements of total evaporative water loss from the plots. Transpiration fluxes for each plot were estimated by an aerodynamic-energy balance approach and compared with the lysimeter data. Plant resistances were computed from the transpiration flux results and the leaf water potential measurements using van den Honert's equation, while canopy resistances were also computed from the transpiration flux using Monteith's equation. The calculated plant resistance decreased by a factor of almost two from morning to mid-afternoon whereas the ratio of canopy and stomatal resistance was constant during most of the day. (Author's abstract)
W86-00506

YIELD, COMPOSITION AND QUALITY OF TALL FESCUE AS INFLUENCED BY N FERTILITY AND SOIL WATER AVAILABILITY,

Russell Research Center, Athens, GA.
D. P. Belesky, S. R. Wilkinson, and F. McHan.
Communications in Soil Science and Plant Analysis, Vol. 15, No. 8, p 945-968, July, 1984. 10 Tab, 20 Ref.

Descriptors: *Fescue, *Crop yield, *Water stress, *Nitrogen, *Fertilizers, Soil water, Forages, Plant growth, Leaves, Stomatal resistance, Transpiration, Toxicosis.

A study was designed to evaluate yield, quality and composition of tall fescue (Festuca arundinacea Schreb.) as influenced by water stress under 0, 100, and 400 kg N/ha during autumn in the southeastern U.S. Four replicates of each treatment were imposed in a completely random design in the field. The experiment was conducted in two successive years with treatments applied to an adjacent area to eliminate residual or carry-over effects. Water status was verified by gypsum block, tensiometer, and determination of leaf stomatal resistance. Plant tissue was harvested three times during autumn and again in the following spring. Forage yield total was not significantly affected by soil water stress, apparently due to compensatory growth during recovery periods. Soil water appeared to be more rapidly depleted under 400 kg N/ha than other N treatments. Increasing N fertilizer significantly increased leaf area, leaf number, and was inversely related to the number of senesced leaves. Stomatal resistance was increased under water stress conditions when N was limited (ON) but not when 400 kg N/ha was applied. Consequently, plots receiving 400 kg N/ha continued to transpire even during periods of limited soil water, but transpired less during subsequent stress periods. Kjeldahl and NO3-N were increased by application of fertilizer N and only NO3-N was significantly increased by water stress in this study. Although high input of fertilizer N minimized the impact of mild water stress on the physiological response of tall fescue, eventual stand loss occurred. Water stress had no effect upon nonstructural carbohydrates, in vitro dry matter digestibility or the elements P, K, Ca, Mg, Cu and Zn. Consequently the factors associated with the expression of tall fescue toxicosis during autumn are more subtle in expression, and do not appear to be associated with alterations in major nutritive components. (Author's abstract)
W86-00512

WATER RELATIONS IN XEROPHYTIC PLANTS (VODNI PROVOZ SUCHOMILNYCH ROSTLIN),

Vysoka Skola Zemedelska, Brno (Czechoslovakia). Faculta Lesnicka.
M. Penka.
Acta Universitatis Agriculturae (Brno) Series C (Facultas silviculturae), Vol. 52, No. 3-4, p 243-257, 1983. 5 Fig, 34 Tab.

Descriptors: *Xerophytes, *Water relation, Transpiration, Drought resistance, Succulents, Halophytes, Soil-water-plant relationships, Roots, Shoots, Plant physiology.

The objective was to study the water relations in xerophytic plants. The term 'xerophytes' was defined and a classification of the plants suggested (sclerophilous, malacophilous, stenohydric, euryhydric, hydrostable, hydrolabile plants). Attention was also given to division of the plants as based on the depth of rooting with respect to their water intake and outgo (water balance). Moreover, the root:shoot (R/S) ratio was evaluated, account being taken of the anatomy of vascular bundles and their conductivity. As for the water relations in the shoot system, further essential features were assessed, primarily the conduction and outgo of water in relation to anatomical characteristics of vascular bundles and to anatomical structure of leaves, of assimilating stems. The Schimper theory on xerophytism was confronted with Maximoff's views of xerophytes approached from the physiological standpoint. The difference between transpiration and resistance of plants against drought was discussed in detail; high resistance against drought was found to be a feature characteristic of all xerophytes. The observations indicated that xerophytes, if supplied well by water, either equalled to or exceeded the transpiration of mesophytes and hygrophytes. Basing on the ability to resist the impact of drought, xerophytes would be divided into following categories: annual, sclerophilous evergreen, xeromorphous leafless, perennial deciduous, reducing transpiration area during the spell of dry weather, and succulent. The last category of xerophytes was subdivided into leaf succulents, stem succulents, and underground succulents. Since halophytes stand near xerophytes, the oligotrophic plants into which halophytes are usually included were classified first. Of individual features of the water relations were discussed mainly: water outgo, osmotic conditions, and physiological drying. The terms 'hygrohalophytes' and 'xerohalophytes' were also mentioned, in relation to variations in the soil moisture and salts. (Author's abstract)
W86-00592

SOIL-PLANT-WATER MODEL WITH A CASE STUDY IN A FORESTED CATCHMENT,

Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Ecologie des Ressources Renouvelables.
T. Huillet, and J. Lauga.
Ecological Modelling, Vol. 27, No. 3/4, p 235-250,

April, 1985. 8 Fig, 2 Tab, 25 Ref.

Descriptors: *Water use, *Plants, Model studies, Forest watershed, Catchment areas, Hydrologic models, Water budget, Evaporation, Transpiration, Mathematical models.

A model is presented to sketch the mean features of soil-plant-atmosphere interactions. Many earlier studies have been interested in mathematical modelling of water cycling in small watersheds. Among so called conceptual models of processes there is a distinction between spatial models taking into account some aspects of spatial heterogeneity and lumped models such as the CREC model. The main features of the CREC model are described. The dynamic model proposed covers a period of 1 year, and the spatial unit chosen is a forested catchment area. The transpiration process is shown to differ from evaporation over a water surface as soon as a water deficit develops, corresponding to the closure of stomata and a sharp reduction in transpiration, although the evaporative power of the air may still be strong. The mathematical model is first discussed with reference to hydrological processes over the watershed, followed by the addition of state equations which describe the living part of the watershed and its water consumption processes. The ability of the soil-plant-atmosphere model presented to separate transpiration and evaporation rates makes it possible to grasp some characteristics of the daily evolution of these variables. The calibration is not yet reliable enough but it provides a useful guide for future data collection. Some variables, such as mean daily leaf water potential, are biologically ill-defined. To improve the model optimization should be possible, although it should be noted that the uniqueness of the solution is not guaranteed with scarce data usually found in ecology. (Baker-IVI)
W86-00595

CANOPY DYNAMICS OF EUCALYPTUS MACULATA HOOK. III; EFFECTS OF DROUGHT,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
E. W. Pook.
Australian Journal of Botany, Vol. 33, No. 1, p 65-79, 1985. 8 Fig, 4 Tab, 26 Ref.

Descriptors: *Drought, *Eucalyptus, *Canopy, New South Wales, Leaf-shedding, Wilting, Bark-splitting, Defoliation, Drought resistance, Trees, Water deficit.

The severe 7-month drought in coastal and adjacent tablelands regions of New South Wales in the latter half of 1980 caused heavy leaf-shedding, wilting of persistent foliage and bark-splitting in forest eucalypts. Defoliation of individual sample trees of Eucalyptus maculata ranged from 50 to 97% of pre-drought leaf area. Leaf area index of a stand of E. maculata was reduced from c. 4.3 to 0.8. E. maculata was less susceptible to drought than E. globoidea and E. pilularis but more susceptible than E. paniculata in mixed forest on the same site. Rapid recovery of the canopy occurred in autumn after the break of the drought and leaf areas of all sample trees attained pre-drought values or above by summer 1981-82. Leaf-shedding in response to severe water deficit appears to have been of adaptive significance in enhancing tree survival in a drought of this duration. (Author's abstract)
W86-00596

2J. Erosion and Sedimentation

HYDROLOGY, HYDRAULIC, AND SEDIMENT CONSIDERATIONS OF THE TENNESSEE-TOMBIGBEE WATERWAY,

Corps of Engineers, Mobile, AL. Mobile District.
For primary bibliographic entry see Field 6G.
W86-00336

EFFECTS OF SOIL EROSION ON SOYBEAN YIELDS AND CHARACTERISTICS OF CECIL-PACOLET SOILS,

Southern Piedmont Conservation Research Center, Watkinsville, GA.
A. W. White, R. R. Bruce, A. W. Thomas, G. W. Langdale, and H. F. Perkins.
Erosion - Productivity Investigations, 1982-83, Research Report No. IRC 060184, June 1984. 36 p, 11 Fig, 11 Tab.

Descriptors: *Soil erosion, *Erosion, *Crop production, *Crop yield, *Soybeans, *Georgia, *Plant growth, Baseline studies, Soil water, Piedmont, Rainfall, Growth, Data collections, Infiltration, Soil horizons, Potassium, Magnesium, Phosphorus, Minerals, Soil conservation.

Cooperative studies on 24 farm fields over a seven-county area in the Southern Piedmont of Georgia were conducted in 1982 and 1983 to evaluate the effects of soil erosion on soybean growth and production. Replicated plots were established on Cecil-Pacolet soils in slightly, moderately, and severely eroded areas in each field. Severely eroded soils had markedly lower levels of P compared to slightly eroded soils, while K and Mg were lowest on slightly eroded areas. Erosion reduced plant growth, yields, and stands. In 1982, bean yields averaged 41.3, 28.1, and 19.8 bushels/acre for the slightly, moderately, and severely eroded areas. Analysis of rainfall data for both years showed a 2.7 bushel/acre yield increase per inch of rainfall on the slightly eroded soils. Soil water studies in 1982 showed that slightly eroded sites were well supplied with water more than 40% of the time, compared with 29 and 27% of the time on moderately and severely eroded sites, respectively. These results suggest that there is less infiltration of rainfall into eroded soils, and increased rainfall does not necessarily increase yields on eroded soils. These findings also indicate that erosion is a very serious problem on Southern Piedmont soils and can cause drastic reduction in crop yields.
W86-00339

EFFECTS OF SOIL EROSION ON SOYBEAN PRODUCTION IN THE SOUTHERN PIEDMONT OF GEORGIA IN 1982,

Southern Piedmont Conservation Research Center, Watkinsville, GA.
For primary bibliographic entry see Field 4C.
W86-00340

PHOTOGRAMMETRIC TECHNIQUES FOR MONITORING SOIL EROSION,

Georgia Univ., Athens. Dept. of Geography.
R. Welch, T. R. Jordan, A. W. Thomas, and J. W. Ellis.
Photogrammetry - Soil Erosion Investigations 1983, Research Report No. IRC 09083, September, 1983. 22 p, 6 Fig, Tab 1, 5 Ref.

Descriptors: *Monitoring, *Soil erosion, *Photogrammetry, *Photography, *Aerial photography, *Channel erosion, *Gully erosion, *Bank erosion, Soil conservation, Erosion rates.

The potential of photogrammetric techniques for monitoring soil erosion is described along with the work accomplished by the USDA-ARS Southern Piedmont Conservation Research Center and the University of Georgia between March 1982 and September 1983. Photogrammetry can be used to obtain highly accurate X, Y, and Z terrain coordinates of fragile erosion surfaces recorded on stereo photographs. Analog photogrammetric techniques usually require the use of costly stereo-plotters and the services of a trained photogrammetrist. Analytical photogrammetric techniques involve the measurement of image coordinates and their transformation into X,Y,Z terrain coordinates by computational procedures. Four sites on the Southern Piedmont Conservation Research Center property near Watkinsville, Georgia are being monitored by sequential photogrammetry for stream channel erosion, roadbank-type erosion, gully formation and field erosion, respectively. Further work is needed on the use of aerial photography in conjunction with photogrammetric methods to monitor the topographical changes of larger areas.
W86-00342

BEACH CHANGES AT NAUSET INLET, CAPE COD, MASSACHUSETTS: 1670-1981,

Woods Hole Oceanographic Institution, MA.
For primary bibliographic entry see Field 2L.
W86-00379

FACTORS INFLUENCING INORGANIC TURBIDITY IN A GREAT PLAINS RESERVOIR,

Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-00440

SEDIMENT LOSSES FROM CROPLAND FURROWS OF DIFFERENT GRADIENTS,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
L. D. Meyer, and W. C. Harmon.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 448-461, March/April, 1985. 3 Fig, 6 Tab, 23 Ref.

Descriptors: *Sedimentation, *Erosion, *Soil loss, *Furrows, Cropland, Gradients, Simulated rainfall, Slope, Rill erosion, Rainfall, Runoff.

Soil losses from fields with bedded or ridged rows depend greatly on the row-furrow gradient and row length. Bedded rows with furrow gradients ranging from 0.5 to 6.5% were subjected to a series of simulated rainstorms. Erosion from the row sideslopes was the same at all furrow gradients. Furrow losses increased rapidly between 0.5 and 2.0% gradient, increased only slightly from 2.0% to 5.0%, and again increased rapidly between 5.0 and 6.5%. Losses increased more than 5 times as intensity was increased from 26 to 70 mm/h intensity and more than doubled again from 70 to 108 mm/h. When longer rows were simulated by adding inflow to the furrows, soil losses increased only slightly faster than furrow length until major rilling began. Computation of USLE slope length exponents along the furrows gave values of about 0.1 at 0.5% gradient and near 0.2 at 2.0% and 3.5%. All sediment lost from 0.5% furrows eroded from the row sideslopes. For furrows of 2.0, 3.5, and 5.0% at lengths less than 30 m, more of the lost sediment eroded from the row sideslopes than from the furrows. More of the sediment lost at 6.5% gradient eroded from the furrows for lengths greater than 10 to 20 m. The clay sized portion of the total sediment lost from the furrows decreased as furrow gradient increased, although the amount of loss for this size was about constant unless rilling was serious. Some deposition of silt and sand sized sediment in the furrows occurred at 0.5% gradient, but all such sizes were transported at gradients of 2.0% and steeper. Sediment scoured by flow along steeper and longer furrows was predominantly silt and sand sized. (Baker-IVI)
W86-00467

FIELD EROSION ESTIMATED FROM 137CS ACTIVITY MEASUREMENTS,

Wisconsin Univ.-Madison. Dept. of Agricultural Engineering.
J. R. McHenry, and G. D. Dubenzer.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 480-496, March/April, 1985. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Cesium radioisotopes, *Soil erosion, *Estimating, Soil loss, Erosion control, Cultivation, White Clay Lake Watershed, Wisconsin, Fallout.

Soil samples were collected from fields and wooded sites in White Clay Lake Watershed, Wisconsin. The watershed consists of some 1100 ha of rolling land largely devoted to intensive agriculture. The cultivated fields sampled are farmed in an oats-alfalfa-corn rotation. Fallout Cs-137 concentrations in the soil pedons was used as a tracer or tag in studies conducted in this area in 1974 and 1976. In 1980, after 4 to 6 years of additional cultivation, the fields were again sampled and Cs-137 measured. The results demonstrate that a considerable movement of soils occurs within the cultivated fields. The fallout of Cs-137 was deemed

useful as a tracer of soil particle movement to estimate erosion rates and amounts of soil movement. A comprehensive within field budget of soil movement can be determined by using the Cs-137 procedure together with a grid of sampling sites. Estimates of transport of soil into and out of the field also can be made. These measurements can be made at any given time. Accuracy of the soil loss or gain measurements will depend on the accuracy of the determination of the base level of Cs-137 content and on the detail of the sampling grid of soil profiles. If desired, predetermined precision for each measurement of Cs-137 is possible by use of available nuclear counting techniques. (Baker-IVI)
W86-00472

ESTIMATING SOIL DETACHMENT CAUSED BY RAINDROP IMPACT,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2B.
W86-00494

INTERRILL SOIL EROSION - PART I: DEVELOPMENT OF MODEL FQUATIONS,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
J. E. Gilley, D. A. Woolhiser, and D. B. McWhorter.
Transactions of the American Society of Agricultural Engineers, Vo. 28, No. 1, p 147-153 and 159, January/February, 1985. 4 Fig, 4 Tab, 34 Ref.

Descriptors: *Soil erosion, *Rain, *Interrill erosion, *Model studies, Mathematical equations, Sediment transport, Overland flow, Rainfall intensity.

Model equations were evaluated which are used to estimate interrill soil erosion. The equations developed serve to complement existing erosion models. The accuracy of comprehensive erosion models can be improved if more reliable formulas for predicting overland flow depth, soil detachment and sediment transport capacity are identified. The soil erosion process in the interrill overland flow range is governed by soil detachment from raindrop impact and the transport of soil materials by shallow overland flow. Both of these processes may be significantly influenced by depth of overland flow. Model equations are identified which include the effects of varying overland flow depth on soil detachment and transport. Overland flow depth was determined by the Darcy-Weisbach equation. The Darcy-Weisbach friction coefficient was estimated from an empirical relation including rainfall intensity and flow Reynolds number. A dimensionless equation was used to predict depths of overland flow for varying rainfall intensities and surface roughness. Soil detachment by raindrop impact was represented as the product of a soil detachment factor and the maximum impact pressure at the soil-water interface caused by raindrop impact. Impact pressure was estimated from an empirical equation involving drop impact velocity, drop diameter and water layer depth. Because raindrop size distribution, drop velocity and overland flow depth appear explicitly in the detachment equation, it may prove useful in evaluating results of erosion studies obtained using rainfall simulators with different raindrop characteristics. The sediment transport capacity of runoff was estimated as the product of a sediment transport factor, bottom shear stress and flow velocity. Bottom shear stress was represented as the product of specific weight of water, water depth and channel slope. This relation appeared to provide proper estimates of sediment transport capacity. The data base used to test the model equations was limited. As complex, individual erosion mechanisms become better defined, more reliable and comprehensive soil erosion models can be developed. (Baker-IVI)
W86-00495

INTERRILL SOIL EROSION - PART II: TESTING AND USE OF MODEL EQUATIONS,

Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
J. E. Gilley, D. A. Woolhiser, and D. B. McWhorter.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 154-159, January/February, 1985. 11 Fig, 2 Tab, 7 Ref.

Descriptors: *Soil erosion, *Rainfall, *Interrill erosion, Rain, Intensity, Mathematical equations, Model studies, Shear stress, Slope, Sediment transport, Overland flow.

The effects of varying discharge and slope steepness on interrill soil erosion was measured. The previously identified model equations were tested on experimentally obtained information. The interrill overland flow range was identified and the influence of slope length on interrill erosion was examined. A rainfall simulator was used to measure interrill runoff and erosion under lab conditions for a Nunn clay loam soil. Discharge and slope steepness were included as experimental variables. Inflow was added at the top of the test section in a portion of the study to simulate greater slope lengths. Soil loss consistently increased with slope steepness when inflow was not added. Greater discharge rates, resulting from addition of inflow, caused larger erosion rates in some instances and reduced rates of erosion in others. In general, rilling was observed to occur at smaller discharge rates as slope steepness was increased. The experimentally obtained information was used to test previously identified model equations. In general, predicted soil loss rates agreed well with measured data. Analyses of experimental information collected in the present study suggest that previously identified detachment and transport relations are appropriate for estimating interrill soil erosion. The overland flow length required for establishment of critical shear stress is expected to change from a few meters to several hundred meters as slope gradient is decreased from 10 to 1%. Slope length affects interrill soil erosion because water depth increases with downslope distance. Water depth in turn influences soil detachment and overland flow sediment transport capacity. Soil erosion at a particular downslope distance is dictated by soil detachment or sediment transport capacity characteristics existing at that particular location. (Baker-IVI)
W86-00496

SOIL LOSS FROM COTTON WITH CONSERVATION TILLAGE,

Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 4D.
W86-00497

SEDIMENTATION IN A BLAST-ZONE LAKE AT MOUNT ST. HELENS, WASHINGTON - IMPLICATIONS FOR VARVE FORMATION,

New Mexico Univ., Albuquerque. Dept. of Geology.
R. Y. Anderson, E. B. Nuhfer, and W. E. Dean.
Geology, Vol. 13, No. 5, p 348-352, May, 1985. 3 Fig, 1 Tab, 18 Ref. NAF grant EAR 81-13072.

Descriptors: *Sedimentation, *Varves, *Coldwater Lake, *Washington, *Mount St. Helens, Volcanoes, Erosion, Vegetation, Sediment yield, Turbidites, Precipitation, Seasonal variation.

The basin that holds Coldwater Lake was formed when a debris avalanche from the May 18, 1980, eruption of Mount St. Helens, Washington moved down the Toutle River and blocked the confluence of Coldwater and south Coldwater creeks. The drainage area of the lake contains highly erodible materials. Vegetation was virtually absent from the devastated area after the eruption, and large areas of bare ground were still present at the time of the studies. Sediment collected from June 1982 through August 1984 in traps in the newly formed lake in the blast-impact area recorded a sediment yield that is about two orders of magnitude greater than for comparable basins with vegetation and similar precipitation. Most sediment was mobilized by storms and runoff at the onset of the wet season. The sedimentation response to strongly seasonal precipitation, in the absence of vegetation, produced turbidites and graded annual couplets. The seasonal shift from turbidite to nonturbidite deposition, followed by the slow accumulation of clay, was a consequence of the strongly seasonal distribution of precipitation. Texturally and structurally, the laminated and graded silt layer and the silt-clay couplets bear a close resemblance to some of the graded clastic varves forming in proglacial lakes. (Moore-IVI)
W86-00517

MODELLING OF 210PB BEHAVIOUR IN THE CATCHMENT AND SEDIMENT OF LAKE TALI KARNG, VICTORIA, AND ESTIMATION OF RECENT SEDIMENTATION RATES,

Melbourne Univ., Parkville (Australia). Marine Chemistry Lab.
J. D. Smith, and T. F. Hamilton.
Australian Journal of Marine and Freshwater Research, Vol. 36, No. 1, p 15-22, 1985. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Lead radioisotopes, *Lake sediments, *Lake Tali Karng, *Victoria, Sedimentation rate, Catchment area, Model studies.

Lake Tali Karng, the only natural deep-water highland lake in Victoria, Australia, is situated at an altitude of 915 m on the south side of the Victorian Alps. A sediment core was taken from the deepest part of the lake. The flux of unsupported Pb-210 to the sediment is about 145 mBq/sq cm/year. Over the last 100 years, about 75 cm of sediment has accumulated at an average rate of 150-200 mg/sq cm/year. Calculations using two models to convert Pb-210 activity-depth profiles to age-depth profiles indicate that the sedimentation rate has increased slightly over the last 100 years. It is estimated that about 14% of the Pb-210 falling in the catchment reaches the lake sediment, but depending on the assumptions made, the possible range is 7-60%. The contribution of Pb-210 from the catchment may be related to the rugged topography of the region, with some influence from the above-average uranium concentrations in the rocks. Lake Tali Karng with its unique environment is an excellent site for the study of the behavior of Pb-210 in a catchment and for development of models of relationships between different sources of Pb-210. (Moore-IVI)
W86-00520

SEDIMENTATION OF PARTICULATE MATERIAL IN NORDASVANNET, A HYPERTROPHIC, LAND-LOCKED FJORD IN WESTERN NORWAY,

Bergen Univ. (Norway). Inst. of Marine Biology.
For primary bibliographic entry see Field 2L.
W86-00527

STATISTICAL MODELING OF HISTORIC SHORE EROSION RATES ON THE CHESAPEAKE BAY IN MARYLAND,

Naval Academy, Annapolis, MD. Dept. of Mathematics.
R. K. Spoeri, C. F. Zabawa, and B. Coulombe.
Environmental Geology and Water Science, Vol. 7, No. 3, p 171-187, 1985. 7 Fig, 8 Tab, 75 Ref.

Descriptors: *Statistial models, *Shore erosion, *Chesapeake Bay, *Maryland, Erosion rate, History, Storms, Tides, Waves. Littoral drift, Regressionn analysis, Discriminant analysis.

Few strong relationships exist along the Chesapeake Bay shoreline between the historic erosion rate and the distribution of any of several coastal parameters which were defined and tested using traditional regression and discriminant analysis procedures. To develop a simple predictive equation for shore erosion that could be used by coastal managers, the entire Chesapeake Bay shoreline was partitioned into naturally occurring reaches 2-5 km in length, and the historic erosion rate on each reach was modelled as a function of five variables: (a) shoreline type; (b) '100-year' storm surge height; (c) mean tidal range; (d) wave climate; and (e) potential littoral drift rate. The statistical analysis yielded a multiple correlation coefficient (r sq) of 30.8%; discriminant analysis showed only the first two variables listed above are useful predic-

tors (i.e., statistically significant) of historical erosion rates. A 95-mile portion of the same bay shoreline in Queen Anne's and Talbot counties was then partitioned into shorter reach lengths (1/2-2 km) and more variables were included. The multiple correlation coefficient (r sq) improved slightly to 32.9%, but only shoreline type and potential litoral drift rate were found to be useful predictors of historic erosion rates. Curiously, the ability to model statistically the historic shore erosion rate is best on those reaches already substantially protected by structures. For Queen Anne's and Talbot counties, the multiple regression coefficient improved to 61.5% when only reaches 1/2-2 km in length protected by structures were considered. (Author's abstract)
W86-00556

SEDIMENT ACCUMULATION RATES IN AN ALASKAN ARCTIC LAKE USING A MODIFIED 210PB TECHNIQUE,

Alaska Univ., Fairbanks. Inst. of Marine Science.
For primary bibliographic entry see Field 2H.
W86-00612

2K. Chemical Processes

MATHEMATICAL MODELING OF COMPLEX FORMATION OF METALS AND ITS APPLICATION TO THE INTERPRETATION OF PHYSICOCHEMICAL PROCESSES IN NATURAL WATERS (MATHEMATISCHE MODELLIERUNG DER KOMPLEXBILDUNG VON METALLEN UND IHRE NUTZUNG BEI DER INTERPRETATION PHYSIKOCHEMISCHER PROZESSE IN NATURLICHEN WASSERN),

Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
R. Fischer, and H. Reissig.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 1, p 3-18, 1984. 9 Fig, 3 Tab, 7 Ref.

Descriptors: *Mathematical models, *Chemical complexation, *Metals, *Natural waters, Physicochemical properties, Ligands, Temperature, Hydrogen ion concentration, Iron, Oxidation.

A mathematical model is presented for the calculation of the concentrations or activities of complex compounds at thermodynamic equilibrium. Ten central atoms and ten ligands which form 400 complexes at the most can be included in the model. Complex stability constants, total concentrations of the central atoms and ligands, temperature and pH-value constitute input quantities. Activity and temperature dependence of the stability constants are covered by respective subprograms. The model is tested by the migration rate of iron(II) within a sand-filled column with a cation-exchange capacity of 1 mval/100 g solid matter: If there is an excess of sulfate, the iron(II)-breakthrough will be considerably earlier, the same holding for the EDTA-complex, whereas by means of EDTA the iron(II) bonded to the soil by ion exchange can be redissolved. In the batch experiment also the rate of oxidation of iron(II) is dependent on the degree of complexing. The model can be extended for dissolving, precipitation and redox processes. (Author's abstract)
W86-00394

EXPERIMENTS ON AEROSOL SCAVENGING BY NATURAL SNOW CRYSTALS, PART I: COLLECTION EFFICIENCY OF UNCHARGED SNOW CRYSTALS FOR MICRON AND SUBMICRON PARTICLES,

Hokkaido Univ., Sapporo (Japan). Div. of Environmental Structure.
For primary bibliographic entry see Field 2B.
W86-00426

RETENTION AND RELEASE OF SELECTED MAJOR AND MINOR METALS BY THE ALTAMAHA RIVER MARSH ECOSYSTEM,

Savannah State Coll., GA. School of Science and Technology.
For primary bibliographic entry see Field 2L.
W86-00431

SEDIMENT ACID NEUTRALIZATION IN SOFTWATER LAKES,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 2H.
W86-00432

FLUCTUATION IN NUTRIENTS DURING TIDAL CYCLES AT OYSTER BEDS IN THE RIVER PENZE (NORTH FINISTERE) (FLUCTUATIONS DES NUTRIMENTS AU COURS DE LA MAREE SUR LES PARCS OSTREICOLES DE LA RIVIERE PENZE (NORD-FINISTERE)),

Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).
For primary bibliographic entry see Field 2L.
W86-00447

STATE OF METAL IONS IN NATURAL WATERS,

Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
P. N. Linnik, and B. I. Nabivanets.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 4, p 335-361, 1984. 1 Fig, 3 Tab, 178 Ref.

Descriptors: *Natural waters, *Metals, *Ions, Chemical complexes, Heavy metals, Organic compounds, Water analysis, Ligands.

Data obtained from the literature and original research showing the concentrations of microelements in oceans, seas, lakes and reservoirs, and rivers; the ratios of complexed and uncomplexed forms of macro- and microelements in some lake waters; and the molecular mass of metal complexing compounds are presented, and metal complexation is reviewed. A research method for determining the state of metal ions in natural waters also is described. Microelements discussed include Fe, Al, Mn, Zn, Cu, Ni, Co, V, Mo, Ti, Rb, Ag, Cr, and Pb. Ratios of aquacomplexes and inorganic compounds to complexes with macromolecular ligands in lake water are given for Mg, Ca, Ba, Fe, Al, Mn, Cu, Zn, Cd, Pb, Ni, Cr, Sc, La, Ce, and Th. Complexing substances involved with Fe include humic compounds, fulvic acids, and dissolved organic compounds, with molecular masses ranging from less than 5,000 to 20,000. Cd, Cu, and Pb have been found complexed with dissolved organic compounds with weights from less than 1,400 to over 45,000; Cu also complexes with fulvic acids and protein-like compounds. Mn is found complexed with dissolved organic compounds of weights from 500-150,000. Hg is found in complexes with dissolved organic compounds of 500-300,000 molecular weight. The most general characteristics of the state of metal ions in natural waters are metal distribution among suspended, colloid-dispersed and truly dissolved forms; concentration of free (noncomplexed) metal ions; charge sign; molecular (ionic) mass of complex or polynuclear compounds; kinetics of the complexing process; degree of strength of metal binding to the complex; and degree of metal oxidation. These characteristics of metal ions were employed to develop a flow chart for determination of the state of metal ions in natural waters. Electrophoresis, ion exchange, diffusion, and filtration methods are among the laboratory methods used in determination of the forms of metal ions. (Rochester-IVI)
W86-00537

RELATIONSHIP BETWEEN ORGANIC CARBON AND CHEMICAL OXYGEN DEMAND,

Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
L. Prochazkova, and P. Blazka.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 4, p 383-392, 1984. 2 Fig, 6 Tab, 23 Ref.

Descriptors: *Organic carbon, *Chemical oxygen demand, *Fate of pollutants, Reservoirs, Ponds, Brooks, Rivers, Sediments, Linear regression analysis.

Data on chemical oxygen demand (COD) give the amount of oxygen required for oxidation under fairly severe conditions. This corresponds to the concentration of organic compounds present if inorganic reducing substances are low and negligible. The chemical oxygen demand/organic carbon (COD/OC) ratio was determined for samples from two ponds, one brook, three rivers and four reservoirs. All samples were taken from sampling stations with a low organic load, (2.6-127 mg/l COD and 0.9-38 mg/l OC). In the course of self-purification, the OC concentration in rivers and reservoirs decreases to 8 mg/l, whereas ponds reached minimum values of the same size. The quotient COD/OC varies as the mean value for the individual waters between 2.55 in reservoirs and 3.92 in ponds. The overall trend of the values in the sequence of pond-river-reservoir is decreasing. The variability of the COD/OC ratios both within and between the groups results in artificial intercepts in linear regressions of the two parameters. Quotients larger than four may be associated with sulfur-containing compounds possibly coming from the sediments. The COD/OC ratios may vary with the origin of the samples and the use of a unified ratio in calculations may cause errors which are not negligible. (Moore-IVI)
W86-00540

NITROGEN, PHOSPHORUS, AND ORGANIC CARBON CYCLING IN AN ARCTIC LAKE,

Alaska Univ., Fairbanks. Inst. of Marine Science.
For primary bibliographic entry see Field 2H.
W86-00611

2L. Estuaries

EVALUATION OF MARSH/ESTUARINE WATER QUALITY AND ECOLOGICAL MODELS: AN INTERIM GUIDE,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
R. W. Hall.
Miscellaneous paper EL-82-1, January 1982. Final Report. 24 p, 5 Tab, 91 Ref.

Descriptors: *Estuaries, *Marshes, *Model studies, *Water quality, Coastal marshes, Mathematical models, Wetlands.

This report presents water quality and ecological problems in coastal marshes and estuaries, suggests applicable modeling approaches to problem solution, and provides the basis for the modeling recommendations through a brief summary of water quality and ecological modeling in the marsh/estuarine environment. (Author)
W86-00314

COLUMBIA RIVER ESTUARY HYBRID MODEL STUDIES: REPORT 4, ENTRANCE CHANNEL TESTS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. H. McAnally, N. J. Brogdon, and J. P. Stewart.
Technical Report HL-83-16, September 1983. 147 p, 5 Fig, 20 Tab, 101 Plates, 9 Ref.

Descriptors: *Estuaries, *Channels, *Navigation, *Shoals, *Model studies, *Hydraulic models, *Dredging, Columbia River estuary, Channel improvement.

A hybrid modeling approach using a fixed-bed physical model, numerical models, and analytical techniques was used to study navigation channel shoaling at the mouth of the Columbia River. Sixteen plans for reducing channel maintenance dredging at the existing 48-ft depth and at 55- and 60-ft depths were tested. Effects of the plans on tides and currents were found to be subtle. Non-deepening plans had minor effects on salinity intrusion while channel deepening increased salinities by 1 to 6 parts per thousand up to about mile 18. Only one stuctural plan reduced shoaling below base conditions for the 48-ft channel. Channel deepening increased shoaling considerably.
W86-00357

LONG ISLAND SOUND THAMESVILLE TIDAL-FLOOD MANAGEMENT WATER RESOURCES STUDY, NORWICH, CONNECTICUT.

Corps of Engineers, Waltham, MA. New England Div.
For primary bibliographic entry see Field 4D.
W86-00372

BEACH CHANGES AT NAUSET INLET, CAPE COD, MASSACHUSETTS: 1670-1981,

Woods Hole Oceanographic Institution, MA.
P. E. Speer, D. G. Aubrey, and E. Ruder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-10117 0. Technical Report WHOI-82-40. August 1982. 92 p. 15 Fig, 2 Tab, 22 Ref, 4 Append. Contract/Grant No. NA 80-AA-D-00077(R/B21), DAAG29-81-K-0004.

Descriptors: *Beach erosion, *Beach profiles, Inlets, Tidal effects, Maps, History, Cape Cod, Massachusetts.

A historical study of barrier beach and inlet changes for the Nauset Inlet region, Cape Cod, Massachusetts, was performed to document patterns of beach and inlet change as a preliminary to designing and carrying out field studies of inlet sediment transport. One hundred twenty historical charts from 1670 and 125 sets of aerial photographs from 1938 formed the basis for this study. Specific aspects of barrier beach and inlet change addressed include onshore barrier beach movement, longshore tidal inlet migration, and longshore sand bypassing past the inlet. In an effort to correlate forcing events with barrier changes, an exhaustive study of the local storm climate was performed. Storm induced shifts in inlet position associated with superelevated water levels are rare but significant occurrences. These major inlet relocations have played an important role at Nauset Inlet by shifting the inlet position to the north. Steady northward migration characterized by flow around a bend during ebb tides has occurred since 1972 when a storm breach rapidly shifted the inlet location. The result is a steady northward migration. A third pattern of inlet migration is the growth of the downdrift spit by addition of sediment from ebb tide delta distal bars.
W86-00379

BIOMASS AND MINERAL COMPOSITION OF AQUATIC MACROPHYTES IN THE HYGAM WETLAND, KASHMIR WITH REFERENCE TO SUBSTRATE NUTRIENTS,

Kashmir Univ., Srinagar (India). Dept. of Botany.
S. Kaul.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 1, p 81-91, 1984. 5 Fig, 4 Tab, 29 Ref.

Descriptors: *Wetlands, *Hygam Wetland, *Jammu and Kashmir, *India, *Minerals, *Aquatic macrophytes, Seasonal variation, Macrophytes, Nitrogen, Phosphorus, Potassium, Sodium, Calcium, Magnesium, Dissolved oxygen.

The Hygam wetland is situated at an altitude of 1565 m above sea level and lies in the Kashmir Valley. It is a bird sanctuary with an area of 56 hectares. The wetland is covered by a luxuriant growth of macrophytes dominated by the associations of Phragmites communis, Sparganium erectum, Scirpus lacustris, and Typha angustata. Sediments are fine greyish, the silt and clay forming the major constituents. The geological substratum is chiefly calcite. The studies were carried out at eight sites from March 1975 to February 1976. Among six mineral constituents estimated in the above ground and below ground tissues, calcium, nitrogen, and potassium were found in higher concentrations. The mineral constituents show clearly decreasing concentration during the season of vegetation. In a regression analysis the biomasses show significant multiple regressions to concentrations of chloride-ions, nitrogen and partly TPP and oxygen in the water and sediment. (Baker-IVI)
W86-00400

RETENTION AND RELEASE OF SELECTED MAJOR AND MINOR METALS BY THE ALTAMAHA RIVER MARSH ECOSYSTEM,

Savannah State Coll., GA. School of Science and Technology.
M. P. Menon, and G. S. Ghuman.
Water, Air, and Soil Pollution, Vol. 25, No. 2, p 195-206, June, 1985. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Marshes, *Ecosystems, *Metals, *Altamaha River, *Georgia, Magnesium, Potassium, Zinc, Manganese, Plants, Nutrients, Heavy metals, Uptake.

The periodic uptake of two nutrients (major metals, K and Mg) and two heavy metals (minor metals, Zn and Mn) by two different plant species, Spartina alterniflora and S. cynosuroides that grow on different sites in the marsh islands along the terminal course of Altamaha river (Georgia) was investigated. The metal content was analyzed of the dead species and of the soil and the retention or release of the major and minor metals of each of the two ecosystems were evaluated. No significant correlation was noted between plant uptake of Mn, Zn, K, and Mg and the DTPA or ammonium acetate extractable metals of the same kind in the soil. Although there are seasonal variations in the uptake of metals by both plant communities (S. alterniflora and S. cynosuroides) the maximum occurs at different times. In general, the metal content of the dead material shows a maximum in December. The periodic retention or release behavior of the four metals for the system as a whole is also different for different metals. It appears that the salt marsh along the Altamaha river where S. cynosuroides grows releases larger amounts of Mn than the ecosystem that is populated with S. alterniflora. Zinc is retained by both systems while each of them is replenished with Mg and K annually. (Baker-IVI)
W86-00431

TURBIDITY ENHANCES FEEDING ABILITIES OF LARVAL PACIFIC HERRING, CLUPEA HARENGUS PALLASI,

Oregon State Univ., Newport. Marine Science Center.
G. W. Boehlert, and J. B. Morgan.
Hydrobiologia, Vol. 123, No. 2, p 161-170, 1985. 6 Fig, 2 Tab, 42 Ref. OWRT grant 14-34-0001-1461.

Descriptors: *Turbidity, *Herring, *Larvae, *Feeding, *Estuarine environment, Habitats, Suspended sediments, Fish behavior, Sediments, Volcanic ash, Immature growth stages.

The larvae of many species of fishes inhabit estuaries when turbidity is high, and some species prefer turbid conditions, at least as juveniles. Larval Pacific herring are able to feed at a greater rate under moderate suspensions of fine-grained sediment and volcanic ash than under clear-water control conditions. This ability decreases with increasing suspension level. Two mechanisms are suggested to account for the enhancement of feeding over controls. First, it is suggested that in the small visual field of the larvae, contrast is enhanced by the background provided by the sediment particles. Secondly, the particles scatter light in all directions, possibly resulting in greater illumination of the food particles, which in turn can decrease the transparency of the food particles. Feeding abilities of the larval herring are thus adapted to residence in the turbid estuarine environments occupied during the larval stage. (Baker-IVI)
W86-00444

FLUCTUATION IN NUTRIENTS DURING TIDAL CYCLES AT OYSTER BEDS IN THE RIVER PENZE (NORTH FINISTERE) (FLUCTUATIONS DES NUTRIMENTS AU COURS DE LA MAREE SUR LES PARCS OSTREICOLES DE LA RIVIERE PENZE (NORD-FINISTERE)),

Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).
G. Boucher, and R. Boucher-Rodoni.
Hydrobiologia, Vol. 123, No. 3, p 251-261, April, 1985. 5 Fig, 1 Tab, 35 Ref.

Descriptors: *Nutrients, *Tidal effects, *Oysters, *Penze, *France, *Estuarine environment, Amines, Multivariate analysis, Ammonia.

The importance of short-term fluctuations in nutrients and primary amines over oyster beds during spring and neap tidal cycles was analyzed. The range of the variations recorded over 24 h is of the same order of magnitude as that observed over an annual cycle. Multivariate analysis, taking into account all available parameters concerning the tidal cycles, showed a short-term evolution of primary amines and ammonia nitrogen, independent from that of other parameters. The latter fluctuate in synchronization with the down-and-up-stream flow of the river Penze. The mean ammonia nitrogen concentration is higher during spring tide than during neap tide, and ammonia is more concentrated at the bottom than in the surface water. This higher concentration of ammonia in bottom water is related neither to current speed, not to interstitial water dilution by sediment resuspension. Nutrient exchanges between the sediment and the water column did not seem to be an important source of ammonia, while ammonia excretion by oysters might be the main source of this nutrient at the bottom level, particularly during spring tide. (Author's abstract)
W86-00447

TIDICS - CONTROL OF TIDAL RESIDUAL CIRCULATION AND TIDAL EXCHANGE IN A CHANNEL-BASIN SYSTEM,

Kyoto Univ. (Japan). Dept. of Fisheries.
M. Kashiwai.
Journal of the Oceanographical Society of Japan, Vol. 41, No. 1, p 1-10, February, 1985. 14 Fig, 5 Ref.

Descriptors: *Tidal currents, *Tidal exchange, *Channels, *Basins, Tidal jet, Hydraulic models, Model studies, Oscillations, Water currents, Vorticity, Bays, Tides.

A self-excited oscillation of tidal flow occurs in a tidal channel-basin system with a narrow and high speed inflowing tidal jet. The mechanism of this oscillation was examined through hydraulic experiments. Results show that the oscillation is caused by alternation in the strength of asymmetric residual circulation caused by a biased supply of vorticity by asymmetric tidal vortex pairs, and that the mechanism of alternation also depends on negative feed-back between the residual circulation and the vorticity supply. The unstable state of the flow suggested the possibility of controlling the tidal current and tidal exchange in the channel-basin system and this was confirmed experimentally. Under fixed tidal conditions and with fixed basin dimensions, the tidal residual circulation was controlled to form two strong clockwise and anticlockwise circulations or a single circulation by changing the shape of the bay entrance. (Author's abstract)
W86-00448

HYDRAULIC EXPERIMENT ON TIDAL EXCHANGE,

Kyoto Univ. (Japan). Dept. of Fisheries.
M. Kashiwai.
Journal of the Oceanographical Society of Japan, Vol. 41, No. 1, p 11-24, February, 1985. 12 Fig, 6 Tab, 13 Ref.

Descriptors: *Tidal exchange, *Tidal currents, Hydraulic models, Water currents, Bays, Channels, Mixing, Model studies.

Tidal exchange through a narrow entrance channel was studied experimentally with the use of a simplified hydraulic model. The inflowing water mass, visualized with dye solution, exhibits the shape of a starting plume with a starting vortex pair at its head. Because of their periodical formation by the tide, these are called the 'tidal plume' and 'tidal vortex pair'. The axis of the tidal plume deflects and undulates with a period 2 to 9 times that of the tide. Together with this undulation, the vortex pair becomes asymmetric. A circulating flow is formed in the bay which affects the shape of the inflowing

and outflowing water masses. A part of the inflowing water mass flows out during the subsequent ebb, and this outflowing portion can be divided into two parts. One is the water remaining in the entrance channel at high water which flows out during the first half of the subsequent ebb and the other is the water flowing round the bay in the circulating flow during flood that flows out during the latter half of the subsequent ebb. Both contribute to the exchange ratio, but one can estimate an upper limit for the exchange ratio by neglecting the latter outflow. This neglected portion is considered in the concept of the age composition of outflowing water. The age composition of the bay water shows the existence of intermittent effluence superposed on a trend in the age composition that is similar to that of the well-mixed case. From the analysis of a model consisting of a number of mixing tanks connected in series with a recycle flow, it is concluded that this intermittent effluence occurs in the case of weak mixing due to the effect of circulating flow in the bay but is negligible in the case of strong mixing. (Author's abstract)
W86-00449

OBSERVATIONS OF INTERNAL TIDES IN UCHIURA BAY,

Tokyo Univ. of Fisheries (Japan).
M. Matsuyama, and T. Teramoto.
Journal of the Oceanographical Society of Japan, Vol. 41, No. 1, p 39-48, February, 1985. 9 Fig, 8 Tab, 9 Ref.

Descriptors: *Tidal currents, *Internal tides, *Uchiura Bay, *Japan, Thermocline, Thermal stratification, Oscillation, Standing waves.

Remarkable tidal currents associated with temperature fluctuations in the subsurface layer has been observed in Uchiura Bay. In order to study the characteristics of these tidal currents, current measurements were carried out in November 1972 and October 1974. It was confirmed from the first set of observations in 1972 that the tidal currents above and below the seasonal thermocline oscillate out of phase with each other and the tidal currents are associated with internal tides. In the second set of observations in 1974 not only current measurements but also serial BT lowerings were made. The phase of the thermocline displacements lagged behind the tidal currents by 81 degrees for the semidiurnal constituent and by 83 degrees for the diurnal constituent, and it is thus concluded that the internal tides in Uchiura Bay behave as standing waves. (Author's abstract)
W86-00450

IN SITU MEASUREMENT OF OXYGEN CONSUMPTION RATE IN THE BOTTOM LAYER IN MIKAWA BAY,

Institute of Physical and Chemical Research, Saitama (Japan).
S. Unoki, Y. Saijo, and S. Tawara.
Journal of the Oceanographical Society of Japan, Vol. 41, p 59-62, 1985. 3 Fig, 4 Ref.

Descriptors: *Mikawa Bay, *Japan, *Oxygen consumption, *Eutrophication, *Tidal waters, Salinity, Dissolved oxygen, Water temperature, Water currents, Wind.

Direct estimation of the oxygen consumption rate in the bottom layer of Mikawa Bay (Japan) where eutrophication is in progress was attempted using in situ continuous measurement of oxygen content and other oceanographic parameters. The ten parameters studied included water temperature, salinity, current velocity and direction, and dissolved oxygen. A change was noted in dissolved oxygen concentration from 21 to 25 July 1974 A gradual decrease in oxygen in the deeper layer was noted from 22 July to early morning of 25 July, with some fluctuations which can possibly be attributed to tidal motion. This gradual change was interrupted at 4 am on the 25th by a strong wind which arose on the afternoon of the 24th. The oxygen content in the deeper layer increased suddenly, and the difference in water temperature between the upper and lower layer diminished. An abrupt decrease in salinity in the lower layer at this time suggests mixing of the upper and lower waters. Data suggest that a water mass, in which the temperature and the salinity differ lateraly depending on the ratio of mixing, moves in and out with the tide. It is surmised that at the buoy location the bottom water was stagnant during this period even though it underwent tidal movement. (Baker-IVI)
W86-00451

HEAVY METAL CONTENT OF OYSTER, BLUE MUSSEL AND GROWING WATER IN HANSAN-GEOJE BAY (IN KOREAN),

Fisheries Research an Development Agency, Pusan (Republic of Korea).
For primary bibliographic entry see Field 5C.
W86-00454

MEIOFAUNA ASSOCIATED WITH MANGROVES IN THE HUNTER RIVER ESTUARY AND FULLERTON COVE, SOUTH-EASTERN AUSTRALIA,

Australian National Univ., Canberra. Dept. of Zoology.
M. Hodda, and W. L. Nicholas.
Australian Journal of Marine and Freshwater Research, Vol. 36, No. 1, p 41-50, 1985. 2 Fig, 5 Tab, 21 Ref.

Descriptors: *Invertebrates, *Mangroves *Hunter River Estuary, *Fullerton Cove, *Australia, Estuarine environment, Water pollution effects, Salinity, Particle size, Elevation, Copepods, Nematodes, Oligochaetes.

The Hunter River estuary and adjacent Fullerton Cove (Australia) were chosen for this study, partly because of the extensive stands of a single species of mangrove, Avicennia marina, that occur there and partly because of the range of estuarine conditions present, some of which include industrial pollution. The meiofauna from 14 sampling sites around the Hunter River estuary is described, and the factors influencing total density and relative abundance of nematodes and copepods and some species distributions are discussed. Elevation above low tide mark influenced nematode density, and salinity influenced copepod density and relative abundance. Both nematodes and copepods were most dense near the mud surface, and algal food and the depth of the reducing layer appear to be partially responsible for major differences in the density of these two taxa at different sites. Pollution also influenced the total density of both nematodes and copepods and also the relative abundance of oligochaetes. There was a lack of any statistically significant relationship between the median grain size and either the relative abundance of nematides or copepods or the ratio of nematodes to copepods; pollution or substantial differences in trophic dynamics of the fauna may obscure the relationship. (Moore-IVI)
W86-00521

SEDIMENTATION OF PARTICULATE MATERIAL IN NORDASVANNET, A HYPERTROPHIC, LAND-LOCKED FJORD IN WESTERN NORWAY,

Bergen Univ. (Norway). Inst. of Marine Biology.
P. Wassmann.
Marine Ecology - Progress Series, Vol. 22, No. 3, p 259-271, March, 1985. 7 Fig, 2 Tab, 51 Ref.

Descriptors: *Fjord, *Sedimentation, *Nordasvannet, *Norway, Particulate matter, Wastewater pollution, Seasonal variation, Mineralization, Phosphorus, Chlorophyll a, Biomass, Phytoplankton.

Sedimentation of particulate material to the sea bottom (90 m) was measured in Nordasvannet, a land-locked, highly stratified, west-Norwegian fjord, receiving fresh water from a small glacier-free watershed and untreated domestic sewage from 30,000 persons equivalents. Five cylindrical sediment traps positioned 20, 40, 45, 50, and 65 m below the water surface were deployed from March 1982 to April 1983. Variability of seasonal sedimentation rates was small, especially at greater depths. Sedimentation rates of total particulate material and particulate organic carbon decreased from 594 and 83 at 20 m, to 389 and 58 g/sq m/yr, respectively, in deeper water. Possible reasons for decreasing sedimentation with increasing depth are mineralization in the water column and lack of resuspension in deeper water. However, sedimentation rates of particulate total phosphorus and chlorophyll a equivalents increased between 20 and 45 m depth. These conflicting results were interpreted as a possible consequcnce of specific lower catchment efficiencies of the uppermost traps and artificial mineralization inside the traps. No evidence was found for sedimentational responses on time variations of suspended biomass, yet larger parts of the biomass of the spring phytoplankton bloom settled to the seafloor of Nordasvannet. Besides fecal pellets few recognizable structures were found in the traps. The POC content of the deposited material was high compared to results given in literature and comprised 10 to 21%. It is hypothesized that a large and continuous allochthonous supply of nutrients to Nordasvannet equalizes both primary production and its sedimentation. (Author's abstract)
W86-00527

MINERAL SALTS AND TIDAL CYCLES IN AN ESTUARY IN NORTH BRITTANY (DOURDUFF, FRANCE) (SELS MINERAUX ET CYCLES DE MAREES DANS UN ESTUAIRE DE BRETAGNE NORD (DOURDUFF, FRANCE)),

Centre d'Etudes d'Oceanographie et de Biologie Marine, Roscoff (France).
C. Riaux-Gobin.
Hydrobiologia, Vol. 124, No. 1, p 35-44, May, 1985. 6 Fig, 2 Tab, 26 Ref.

Descriptors: *Nutrients, *Tides, *Estuaries, *Dourduff, *France, Ammonium, Nitrates, Nitrites, Silicon dioxide, Phosphates, River flow, Seston, Resuspension, Seasonal variation.

Short-term variations in nutrient concentrations of water-masses have been studied in a Brittany estuary over several tidal cycles, during winter and summer. NH4(+), NO2(-), NO3(-), SiO2 and PO4(3-) have been measured at a fixed station. The Dourduff estuary (France) is characterized by a very low river discharge (80 l/s during the minimum water runoff and 1 000 l/s during the maximum) and an important tidal range (9 m at spring tides). SiO2 and NO3(-) concentrations are directly related to freshwater flow whereas PO4(3-) is partially adsorbed by seston in the turbid ebb waters. NH4(+) concentration seems to be, in part, dependent upon sediment resuspension: late ebb and onset of flood periods liberate NH4(+) into the overlying water column. Nutrient concentrations are also related to seasons. Nutrient fluxes are insignificant or negative during summer periods, so the estuary imports nutrients for its own regulation whereas during winter periods is exports NO3(-) and SiO2 (ca 50 kg NO3(-) and ca 200 g SiO2 during a single spring tide). The NO3:PO4 ratio is always above 15:1 and can reach 300:1; moreover this ratio fluctuates during the tidal cycle. This imbalances originates in terrestrial discharges of nitrogen compounds. (Author's abstract)
W86-00530

RELATIONSHIP OF CELLULAR PHOSPHORUS IN THE CYANOBACTERIUM NODULARIA TO PHOSPHORUS AVAILABILITY IN THE PEEL-HARVEY ESTUARINE SYSTEM,

Western Australia Univ., Nederlands. Inst. of Agriculture.
K. S. Hamel, and A. L. Huber.
Hydrobiologia, Vol. 124, No. 1, p 57-63, May, 1985. 4 Fig, 2 Tab, 22 Ref.

Descriptors: *Estuarine environment, *Phosphorus, *Nodularia, *Peel-Harvey Estuarine System, *Western Australia, Cyanophyta, Eutrophication, Water pollution sources, Limiting nutrients, Cycling nutrients.

A laboratory-determined 'critical concentration' of phosphorus in the cyanobacterium Nodularia spumigena was used to assess the phosphorus sufficiency of field populations in the Peel-Harvey Estuarine System, Western Australia. Nutrient addition bioassays indicated that phosphorus was the

limiting nutrient. Since river flow, and thus phosphorus input, to the estuary ceases 1-2 months before the onset of Nodularia blooms, the phosphorus contained in these blooms was derived from sediment release and nutrient recycling. A progressive increase in the mean cellular phosphorus concentration of Nodularia from 1981 to 1983 indicated that sediments were releasing a greater amount of phosphorus each year. Although evidence suggests that the biomass of recent Nodularia blooms is now limited by physical factors, the additional phosphorus contained in each bloom will increase the supply of phosphorus to other organisms. Cellular phosphorus concentrations in Nodularia appeared to be correlated with river phosphorus loadings in the Peel Inlet but not in the Harvey Estuary. (Author's abstract)
W86-00531

STATISTICAL MODELING OF HISTORIC SHORE EROSION RATES ON THE CHESAPEAKE BAY IN MARYLAND,
Naval Academy, Annapolis, MD. Dept. of Mathematics.
For primary bibliographic entry see Field 2J.
W86-00556

EVALUATION OF THE RELEVANCE OF SOME ENVIRONMENTAL FACTORS TO THE ESTIMATION OF MIGRATORY TIMING AND YIELD FOR THE BROWN SHRIMP OF PAMLICO SOUND, NORTH CAROLINA,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
M. A. Matylewich, and P. R. Mundy.
North American Journal of Fisheries Management, Vol. 5, No. 2A, p 197-209, Spring, 1985. 4 Fig, 9 Tab, 30 Ref.

Descriptors: *Shrimp, *Migration, *Pamlico Sound, *North Carolina, *Mathematical models, Water temperature, Salinity, Air temperature, Precipitation, River discharge, Shellfish, Prediction,.

A linearized logistic model and a multiple linear model were used to relate environmental factors (week number, water temperature, salinity, air temperature, precipitation, net heating degree days, river discharge) to the time distribution of the cumulative proportion of catch and catch per unit effort of the brown shrimp (Penaeus aztecus), respectively. Multiple regression analysis yielded equations containing the week number, the water temperature, and an interaction term as the independent variables. Predictions of total annual yield and total annual catch per unit effort are made using the migratory time density approach. The time factor, represented by weeks numbered throughout the year, contributes the most in explaining the variation in the migratory timing. Models for predicting migratory behavior and yield in the brown shrimp should consider water temperature to be a significant factor. Although the models are not statistically precise, the empirical predictions are an improvement over existing estimators. (Author's abstract)
W86-00589

NUMERICAL MODEL FOR TIDAL CURRENT IN THE CHANGJIANG RIVER ESTUARY,
Nanjing Hydraulic Research Inst. (China).
S. Zhao.
Oceanologia et Limnologia Sinica, Vol. 16, No. 1, p 18-27, 1985. 10 Fig, 4 Ref.

Descriptors: *Mathematical models, *Tidal currents, *Changjiang River Estuary, Estuaries, Eddy viscosity, Boundary conditions, Costs.

This paper presents a generalized finite difference scheme for the solution of the two-dimensional current equations expressed as being integrated over the vertical. In this paper the Changjiang River Estuary is simulated in order to investigate the effectiveness of the method on tidal current. The computational results agree well with the tidal current field survey data. Plane domain is supposed to consist of triangular elements of weakly acute type. Partial derivatives of order 1 and 2 are defined at nodal points. In the basic equations of tidal current horizontal eddy viscosity term is also considered. This method has a great advantage of having the flexibility to express the configuration. That is, the boundary configuration of the model is more accurate, and an interested area of the computation by the method can be divided into any small elements arbitarily. Moreover, the computational cost of this method is cheaper. (Author's abstract)
W86-00601

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

COMBINED HYDROMETEOR DISTRIBUTIONS FROM THREE PMS PROBES,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
G. L. Gordon.
IN: Cloud Physics in the SCPP: Interim Progress Report, 1983-84, December 29, 1984. p 53-85, 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Measuring instruments, *Cloud physics, *Precipitation, *Lasers, Hydrometeor distribution, Sierra Nevadas, Meteorological data collections, Ice.

The combined hydrometeor distributions observed by three optical array probes are described. The total hydrometeor distribution can be partitioned into several regions of exponential distributions, each having its own slope and intercept. The different exponential regions are probably the result of different growth characteristics occurring at those particular sizes. Use of a single probe is not sufficient for determining total hydrometeor distributions. The overlapping sizes between the probes can be used to eliminate the size bins that have measurement problems, thus producing a spectrum with more valid numbers. In regions of secondary ice crystal production and when there are sufficient large particles, the hydrometeor spectrum can be represented by a single parameter distribution.
W86-00308

GROSSVERSUCH IV: 'EXTENDED AREA' EFFECTS ON RAINFALL,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Atmospheric Physics Lab.
H. H. Schiesser.
Journal of Climate and Applied Meteorology, Vol. 24, No. 3, p 236-252, March, 1985. 15 Fig, 5 Tab, 14 Ref.

Descriptors: *Cloud seeding, *Rainfall, *Hail suppression, Switzerland, Weather modification, Statistical analysis.

Grossversuch IV, the Swiss randomized hail suppression experiment, was designed to test the hypothesis that seeding hail clouds, according to the beneficial competition concept, would decrease the hail kinetic energy. Two different networks of raingages were used to analyze 37 seed and 50 noseed days for possible seeding effects on rainfall during the hail suppression experiment in Switzerland. 'Moving grid' analyses within a range of 100 km of the seeding center showed no statistical evidence of a seeding effect for 24 h-values. For the experimental unit (9 h), and area 'upwind' (with respect to the mean wind direction) of the target showed a statistically significant increase in rainfall of 118% on seed days, although no 'upwind' effect should be expected. Four heavier rainfalls dominate the seed ensemble and are responsible for that effect. But on those days the environmental wind directions and the movements of the single cells (seeded) point in the opposite direction of the 'upwind' area. Despite randomization, the effect must be mainly due to natural variability. Thus other effects in the target or 'downwind' must likewise be regarded as random. There may be a small seeding effect, especially in a shorter time interval. (Moore-IVI)
W86-00424

3F. Conservation In Agriculture

ROW SPACING, PLANT POPULATION, AND WATER MANAGEMENT EFFECTS ON CORN IN THE ATLANTIC COASTAL PLAIN,
Agricultural Research Service, Florence, SC.
D. L. Karlen, and C. R. Camp.
Agronomy Journal, Vol. 77, No. 3, p 393-398, May-June, 1985. 6 Tab, 35 Ref.

Descriptors: *Corn, *Row spacing, *Plant population, *Irrigation scheduling, Water management, Water stress, Fertilizers, Soil water, Crop yield, Computers, Soil water potential.

Lack of water because of erratic rainfall frequently limits corn (Zea mays L.) production of Typic Paleudults in the Atlantic Coastal Plain. Traditionally, wide (96 cm) row spacing and low plant population have been used to prevent water stress, but recently landowners have begun to invest in irrigation systems. Changes in row spacing, plant population, or fertilization practices may be required to achieve maximum water- and nutrient-use efficiency with those systems. Plant population treatments averaging 7.0 and 10.1 plants/sq m in single and twin rows were investigated on a Norfolk (fine-loamy, siliceous, thermic Typic Paleudult) loamy sand during 1980, 1981, and 1982. Three water management (nonirrigated, irrigated using tensiometers (TENS) to measure soil-water potential for scheduling, and irrigated using a computer-based water balance (CBWB) for scheduling), and two fertilization programs were also evaluated in a four-factor split-plot design. Water management and plant population interacted significantly. Planting in twin rows increased grain yield an average of 0.64 Mg/ha (10 bu/A), but planting more than 7.1 plants/sq m significantly increased grain yield only in 1980. Irrigation increased grain yield 150, 161, and 8% in 1980, 1981, and 1982, respectively, as a result of increased kernal weight and number of kernals per ear. Increasing total N, P, and K application beyond 200, 30, and 167 kg/ha, respectively, did not significantly influence grain yield or yield components. Yield advantages of narrow rows can be obtained on Coastal Plain soil which require subsoiling by using a twin-row planting configuration. Irrigation can be scheduled using either tensiometers (soil-water potential) or a computerized water balance without significantly changing corn grain yield, nutrient accumulation, or yield components. (Author's abstract)
W86-00460

PHYSIOLOGICAL RESPONSE OF MEADOWFOAM TO CROP WATER DEFICITS,
Colorado State Univ., Grand Junction. Fruita Research Center.
C. H. Pearson, and G. D. Jolliff.
Agronomy Journal, Vol. 77, No. 3, p 422-426, May-June, 1985. 3 Fig, 1 Tab, 23 Ref.

Descriptors: *Meadowfoam, *Oilseed crops, *Water deficit, Water stress, Irrigation effects, Transpiration, Canopy temperature, Plant water potential, Osmotic potential, Turgor, Stomatal resistance.

The new oilseed crop, meadowfoam (Limnanthes alba), is adapted to wet meadows in its native habitat. The plant has been domesticated and commericalized. Plant water stress during seed development may be a cause of seed yield variation in cultivated fields. A field study was conducted to characterize meadowfoam response to water stress. Treatments included: no irrigation (control); early irrigation, during May (EI); and continued irrigation, from the 1st week of May until crop maturity (CI). Treatments were applied in a randomized complete block experimental design in 1981 and 1982. Plant water potential, turgor potential, osmotic potential, stomatal resistance, transpiration, and canopy temperature were measured at 0600, 0900, 1200, 1500, and 1800 h on several days during flowering and seed development. Generally, crop water deficits were greatest and transpiration was highest at 1500 h, and stomatal resistance

was highest in 1800 h. Meadowfoam maintained an unusually high water potential which did not drop below - 0.8 MPa. The amount of precipitation during flowering in 1982 was the lowest in 16 years. At mid-flowering after 1200 h the control plants had higher crop water deficits, higher stomatal resistance, lower transpiration, and slightly higher canopy temperature than the irrigated plants. The responses became progressively greater by late flowering and early seed fill. Crop water stress in the EI treatment was slight at mid-and late flowering, but because greater at early seed fill. Adaptation of meadowfoam to crop water stress by lowering osmotic potential was minimal. Canopy temperatures of the EI treatment at early seed fill averaged 0.8 C higher than the CI treatment. Meadowfoam requires a high water potential for growth and development, and its tolerance to crop water deficits is low. Stomata of meadowfoam close at relatively high plant water potentials. (Moore-IVI)
W86-00461

SUBIRRIGATION SYSTEM CONTROL FOR WATER USE EFFICIENCY,

Florida Univ., Gainesville. Dept. of Agricultural Engineering.
M. C. Smith, R. W. Skaggs, and J. E. Parsons.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 489-496, March/April, 1985. 13 Fig, 4 Tab, 12 Ref.

Descriptors: *Irrigation, *Water requirements, Irrigation requirements, *Water conservation, Subsurface irrigation, Simulation, Water table, Mathematical equations, Boussinesq equation.

An evaluation was made of water requirements of subirrigation under three methods of system control through both a field experiment and the use of computer simulation analysis. Field experiment results indicate that irrigation water requirements can be reduced by controlling the system such that the midpoint water table depth is allowed to fluctuate within certain limits. The simulation model was based on numerical solutions to the Boussinesq equation and was developed to allow comparison to be made between the control methods using historical weather records. Several simulations were conducted for each control method to optimize the set points for starting and stopping subirrigation for the given method. Using the optimum set points, the simulations pedicted a decreased irrigation requirement when the midpoint water table depth was allowed to fluctuate. The irrigation requirement was decreased by an average of 6.7% over constant water level control for five years of simulations. Much larger differences could have occurred had the set points not been optimized. There is potentially more difference in irrigation water requirements for different set points within a given control method than between two different control methods. There is a good potential for reducing irrigation requirements of subirrigation by using a simple control system employing a float switch triggered bvth field water level. A slight modification in the way in which subirrigation systems are currently controlled can result in decreased water usage. (Baker-IVI)
W86-00473

THREE-DIMENSIONAL INFILTRATION AND TRICKLE IRRIGATION,

Massey Univ., Palmerston North (New Zealand). Dept. of Soil Science.
B. Clothier, D. Scotter, and E. Harper.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 497-501, March/April, 1985. 5 Fig, 12 Ref.

Descriptors: *Soil water, *Trickle irrigation, *Infiltration, Flow, Permeability, Soil properties, Irrigation pattern.

The movement of water into the soil under a trickle emitter occurs in response to equi-dimensional capillary attraction and downward movement as a result of gravity. Soil texture, or more specifically soil pore geometry, determines the relative importance of gravity and capillary forces. The distribution of irrigation water from a drip emitter is dominated by the physical properties of the soil. In some cases the hydraulic properties of soil can be so variable in time and space as to negate the utility of detailed theoretical analyses. Efficient operation of trickle irrigation relies on the ability of the soil to transport the water away from the dripper into the root zone. Soil cracks, biopores and other preferential water flow pathways can act to subvert the uniform distribution of water. Economic returns from horticulture are often sufficient to allow for more elegant engineering design to eliminate the reliance on the soil as a distribution medium. Microjets, minisprinklers and sprinklers are options on such soils. These devices, in contrast to drippers, spread the water out over the soil surface. Minisprinklers can apply water at such a rate (flux density) as to prevent the formation of a surface free water pond. This irrigation water will then infiltrate the soil via smaller pores giving a more uniform wetting patern. The large pores which can only be accessed by free water, remain air-filled. Therefore the wetting of any portion of the root zone is a simple matter of minisprinkler engineering design, divorced from the confounding influence of the soil. (Baker-IVI)
W86-00474

FURROW COMPACTION FOR CONTROLLING EXCESSIVE IRRIGATION WATER INTAKE,

Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
J. T. Musick, F. B. Pringle, and P. N. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 502-506, March/April, 1985. 3 Fig, 4 Tab, 18 Ref.

Descriptors: *Irrigation practices, *Soil compaction, *Furrow compaction, Soil properties, Compaction, Irrigation, Soil water, Corn.

The results of testing the irrigation of SOFT and HARD furrow treatments for corn production are compared with a conventional control treatment of every-furrow (EF) irrigation. The EF treatment had alternating pairs of HARD and SOFT furrows. Soil bulk densities were evaluated below the soil surface in irrigated furrows. Also evaluated were irrigation water application, intake, surface runoff, soil water storage, estimated profile drainage, evapotranspiration, and corn yields. The field study was conducted on Olton clay loam which is a fine, mixed thermic family of Aridic Paleustolls. Wide spacing of furrows had very little effect, while wheel compaction reduced the average water intake during seasonal irrigation from 123 to 82 mm and estimated profile drainage losses from 29.4 to 9.1% of water applied. Tractor-wheel compaction from multiple field operations increased average dry soil bulk densities from 1.26 to 1.62 Mg/cubic m. Irrigated furrows were compacted as a separate tractor pass prior to the preplant irrigation, and effects remained throughout the growing season. The reduced water intake with furrow compaction did not affect corn grain yields. Alternating compacted and noncompacted furrows permits flexibility in irrigating for a range in water intake, depending on water use rates and profile soil water depletion. Irrigation of compacted furrows permits the use of a fixed pumping rate to irrigate a larger area by reducing profile drainage and increasing field application efficiency. (Baker-IVI)
W86-00475

BANANA YIELD AS AFFECTED BY DEFICIT IRRIGATION AND PATTERN OF LATERAL LAYOUTS,

Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
S. C. H. Young, T. W. Sammis, and I.-P. Wu.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 507-510 and 516, March/April, 1985. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Irrigation practices, *Bananas, *Crop yields, *Drip irrigation, Deficit irrigation, Soil water, Evapotranspiration, Clay, Soil properties.

The water requirement of the banana plant for optimum growth and fruit production was determined and the effect of evapotranspiration and yield of deficit irrigation were also considered. The response of the banana plant to different wetting patterns formed by placing drip irrigation laterals at selected locations away from the mat was also investigated. Yield and evapotranspiration increased, as described by a linear relationship, up to the maximum application rate of 1.8 x pan plus effective rainfall (annual effective rainfall is 649 mm). The evapotranspiration associated with the maximum treatment was 2613 mm/year resulting in a yield of 126 t/ha averaged over two years which was considerably higher than the maximum reported yields in the literature of 50 to 60 t/da. Daily application of irrigation water using a drip irrigation system which maintains the soil moisture in a portion of the root zone near field capacity can double banana yields. The location of the drip system in relationship to the banana mat was statistically not significant. (Baker-IVI)
W86-00476

DROPLET SIZE DISTRIBUTION AND WATER APPLICATION WITH LOW-PRESSURE SPRINKLERS,

Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
D. Chen, and W. W. Wallender.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 511-516, March/April, 1985. 9 Fig, 2 Tab, 14 Ref.

Descriptors: *Irrigation practices, *Water distribution, *Sprinkler irrigation, Nozzles, Drop size, Cost analysis, Spacing.

The interpretation of droplet size distribution and water distribution were enhanced over a range of operating pressures for noncircular nozzles. Droplet sizes and water application uniformity for square, double rectangular, and triangular nozzles were compared with the performance of circular nozzles of similar discharge characteristics. Generally, volume weighted mean droplet sizes were larger for noncircular nozzles at a given distance from the sprinkler but circular nozzles produced the largest average droplet size at the outer perimeter of their pattern. This was possible because the circular nozzles projected the water farther than their noncircular comparison nozzles. The soil damage hazard due to large droplets was further compounded by the high water application rate, near the perimeter (doughnut pattern), for circular nozzles operated at low pressures. Square and triangular nozzles produced doughnut shaped patterns only at the lowest pressure tested, 138kPa (20 psi). Cost analysis gave the cost-pressure relation needed as input to the sprinkler selection and spacing decision process. Costs for the noncircular and circular nozzle cases were comparable. Minimum cost sprinkler spacing along the lateral was nearly equal to spacing along the mainline for low-pressure nozzles while for circular nozzles, lateral spacing was a third to a half of mainline spacing. Mainline spacing was less for low-pressure sprinklers, therefore if a retrofit is proposed, closer spacing of lateral lines along the mainline is advised. (Baker-IVI)
W86-00477

INFILTRATION UNDER SURGE IRRIGATION,

Everglades Research and Education Center, Bella Glade.
F. T. Izuno, T. H. Podmore, and H. R. Duke.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 517-521, March/April, 1985. 5 Fig, 3 Tab, 11 Ref.

Descriptors: *Surge irrigation, *Infiltration, Soil water, Infiltrometers, Irrigation practices, Irrigation, Furrow irrigation, Wetting.

Surge irrigation advance studies were conducted in the field to illustrate the relationships between the surge infiltration phenomenon and the corresponding accelerated surge advance rates. Blocked furrow infiltrometer studies in the field were conducted on both surge and continuously irrigated furrows to quantify the reduction in infiltration

rates caused by surged applications. The surge irrigation infiltration phenomenon and its ability to enable the surge benefits to exist was explored. Although surge and continuous infiltration rates are numerically equivalent, a step drop from the high time dependent infiltration rate to the basic rate after one complete surge cycle is the apparent cause of the accelerated advance rates observed under surge irrigation. The step drop in surge infiltration rates results in smaller volumes of applied water required for advance when surge irrigation is used compared to continuous applications. The reduced infiltration phenomenon under surge irrigation appears not to undergo further reduction with subsequent surges of an irrigation. The phenomenon does not appear to be cumulative with successive irrigations of a season. Because of the relationship between infiltration rates and advance, surge irrigation reduces differences in rate of advance between furrows with different levels of compaction. Surge irrigation also reduces advance rate differences caused by repeated irrigations of a furrow. It appears that seasonal and compaction infiltration effects on advance can be reduced by maintaining surge cycle on times below the time where continuous advance curves begin to reflect infiltration differences. Three distinct phases of infiltration occur under surged furrow irrigation. These phases are infiltration into initially dry soil, infiltration into previously wetted soil, and a transition infiltration regime caused by increased wetted perimeters occurring after the first wetting of a furrow section. (Baker-IVI)
W86-00478

UNI-PLOT FOR DRIP IRRIGATION LATERAL AND SUBMAIN DESIGN,

Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
I.-P. Wu.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 522-528, March/April, 1985. 11 Fig, 1 Tab, 12 Ref.

Descriptors: *Drip irrigation, *Design criteria, *Irrigation, Irrigation practices, Infiltration, Hydraulic design.

A uni-plot is presented for drip irrigation lateral and submain design which applies the polyplot concept by plotting the energy gradient line and slope dimensionlessly. The uni-plot concept provides a simple design procedure for lateral and submain design for either uniform or non-uniform slope situations. The pressure variation along a lateral line or a submain is determined by balancing the energy drop by friction and the energy gain (or loss) due to slopes. For the concept of Poly-plot the reference area can be made by using an allowable pressure variation and either the slope profile or the energy gradient line (EGL). The allowable pressure variation is defined as the difference between maximum pressure and minimum pressure in the line which is determined based on the operating pressure and a design criterion of pressure variation expressed as a percentage. The EGL for a single-size lateral or submain is a curve and the EGL for a multi-size lateral or submain can be approximated by a straight line. By applying the concept of poly-plot and plotting the length and energy terms dimensionlessly, two uniplots were developed for lateral (or submain) design for a single size or multiple sizes. The uni-plot can be used for both uniform and non-uniform slope situations and used for checking the acceptability of a design or to design a lateral (or submain) size based on a design criterion. (Baker-IVI)
W86-00479

FURROW FIRMING FOR CONTROL OF IRRIGATION ADVANCE RATES,

Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
K. J. Fornstrom, J. A. Michel, Jr., J. Borrelli, and G. D. Jackson.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 529-531 and 536, March/April, 1985. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Furrow irrigation, *Advance rate, *Furrow compaction, Crops, Compaction, Soil compaction, No-till, Tillage.

An attempt was made to design, build and evaluate a tool which would increase the advance rate of irrigation water in no-till and conventionally tilled furrows. The specific design objectives of the tool were that it should reshape and compact the furrow as well as clear previous crop residue from the no-till furrows. The unit constructed to reshape and compact the furrows consisted of a furrow forming tool and a firming unit for each furrow mounted on a 3 point hitch toolbar. The firming unit consisted of 35 cm diameter V-shaped wheels, hinge mounted with a frame such that suitcase tractor weights could be attached to each row unit. The unit was evaluated by comparing water advance distances in firmed and unfirmed irrigation furrows with the same irrigation flow rates. Tests indicated improved advance rates for both no-till and conventionally tilled plots. Twice the advance distance was obtained in no-till plots when the firming unit with 144 kg of additional weight was used and approximately 40% more in conventionally tilled plots. Water advance distance, in no-till furrows after firming, approached those of the conventionally tilled furrows before firming. Soil cone index values obtained from penetrometer tests indicate that some compaction was obtained to a depth of 10 cm with a weighted firming wheel. A consistent increase in cone index for corrugated and firmed treatments (without weights) was not obtained. Thus the firming device was successful in improving irrigation water advance rates and uniformity of advance. Probable benefits of increased advance rates include reduction in leaching of fertilizers and pesticides and possible reduced soil erosion since smaller furrow flow rates can be used. (Baker-IVI)
W86-00480

SURGE FLOW BORDER IRRIGATION USING AN AUTOMATIC DROP GATE,

Alexandria Univ. (Egypt). Dept. of Agricultural Engineering.
S. M. Ismail, G. L. Westesen, and W. E. Larsen.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 532-536, March/April, 1985. 7 Fig, 6 Ref.

Descriptors: *Border irrigation, *Surge flow, *Gates, Drop gates, Design criteria, Irrigation efficiency, Irrigation practices, Automation.

Surge flow with border irrigation varies from that done with furrows because the outflow rate varies. One device used to control water in this fashion is an automatic drop gate. The gate has several advantages. It opens and closes automatically. The gate can be designed to utilize any available head between the reservoir water surface and the land irrigated. The head ditch can be used as a reservoir. No electronic system or timer is needed to control the cycle. Minimal management is required. The gate is easily designed and economically fabricated. Field experiments were conducted to evaluate border irrigation systems using surge flow and the automatic drop gate and compare surge flow with conventional continuous flow. Surge flow border irrigation resulted in better irrigation efficiency than continuous flow. The automatic surge flow gate that was developed performed as designed and showed the potential for automatic control. The design procedure developed can be used for different flow rate and border sizes. (Baker-IVI)
W86-00481

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

USE OF VEGETATION IN DELINEATING WETLAND BORDERS IN UPPER MISSOURI RIVER BASIN; NORTH-CENTRAL UNITED STATES,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.

For primary bibliographic entry see Field 2H.
W86-00359

SELF-CLEANING, NON-POWERED TRASH SCREENS FOR SMALL IRRIGATION FLOWS,

Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
J. A. Bondurant, and W. D. Kemper.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 113-117, January/February, 1985. 9 Fig, 4 Ref.

Descriptors: *Irrigation canals, *Trash screens, *Maintenance, Weed control, Screens.

Material found in irrigation water which will plug a siphon tube or a gated pipe outlet is collectively called trash. Included are live and dead plant material, fish, snails, worms, insects, aquatic plants, moss, algae, and miscellaneous materials such as plastics and aluminum cans. Three different self-cleaning trash screen configurations are described: the horizontal rectangular screen; the circular, center fed turbulent fountain screen; and an in-stream, submerged screen. The mode of operation to remove trash, screen construction and field test results are presented. Flat trash screens consisting of a frame, a support screen, and a final screen have been found to satisfactorily remove trash and some weed seeds from irrigation flows. These screens are essentially self cleaning if designed correctly. At least 0.20 m (8 in.) of head is usually required for self cleaning operation of either the rectangular screens or the turbulent fountain, center-fed screen. More head is desirable to create adequate turbulence but turbulence can be created using vortex shedding techniques. Most types of trash which come through a turnout can be removed if adequate head is available. An in-stream type trash screen was designed which operated successfully in a stream containing large amounts of pondweed. (Baker-IVI)
W86-00490

EFFECTS OF ARTIFICAL DRAINAGE ON SOIL MINERAL NITROGEN DYNAMICS IN WINTER WHEAT ON THE SOUTHERN PIEDMONT,

Georgia Univ., Athens. Inst. of Ecology.
P. M. Groffman, J. E. Box, Jr., and R. L. Todd.
Communications in Soil Science and Plant Analysis, Vol. 15, No. 9, p 1051-1063, August, 1984. 6 Tab, 18 Ref.

Descriptors: *Drainage effects, *Soil chemistry, *Nitrogen, *Wheat, Subsurface drainage, Mineralization, Nitrification, Crop yield, Fertilizers.

Excess soil moisture is believed to cause reduced levels of soil mineral N and crop production in winter wheat on the Southern Piedmont. Artificial subsurface drainage was used to relieve excess soil moisture and soil mineral N levels, mineralization, nitrification, denitrification and a group of soil properties were analyzed in both drained and undrained treatments. Drainage increased rates of mineralization and nitrification and decreased rates of denitrification, leading to higher levels of soil mineral N in drained plots than in undrained plots. Wheat yields were not affected by drainage, probably because the rate of N applied in spring (80 kg-N/ha) was high enough to counteract the effects of decreased soil mineral N levels in undrained treatments. (Author's abstract)
W86-00513

4B. Groundwater Management

GROUNDWATER DEVELOPMENT, KHARGA OASES, WESTERN DESERT OF EGYPT: A LONG-TERM ENVIRONMENTAL CONCERN,

La Moreaux (P.E.) and Associates, Inc., Tuscaloosa, AL.
P. E. LaMoreaux, B. A. Memon, and H. Idris.
Environmental Geology and Water Science, Vol. 7, No. 3, p 129-149, 1985. 20 Fig, 3 Tab, 139 Ref.

Descriptors: *Groundwater management, *Water resources development, *Egypt, Groundwater potential, Wells, Artesian wells, Deserts, Hydrogeology, Water quality.

The groundwater reserves in Kharga Oases have been studied for the long-term socioeconomic development in the area. The Nubian Sandstone, which consists of a thick sequence of coarse clastic sediments of sandstone, sandy clay interbedded with shale, and clay beds, forms a complex aquifer system. The Nubian Aquifer has been providing water to artesian wells and springs in the Kharga Oases for several thousand years. Groundwater in the Kharga Oases is withdrawn from springs and shallow and deep artesian wells. Nearly all the wells originally flowed, but with the exploitation of groundwater from deep wells for irrigation beginning about 1959, the natural flows declined as more and more closely spaced deep wells were drilled. By 1975 many deep wells had ceased to flow. The water demand in the area has been met by pumping both shallow and deep wells. The total annual extraction from deep wells has fluctuated over the year, however, the annual withdrawal from deep wells has exceeded extraction from shallow wells. About 1.7 billion cu m of water was withdrawn from the combination of shallow and deep wells during the period 1960-1980. The Nubian complex aquifer in the Kharga Oases has a very large groundwater potential that could be exploited and beneficially used for a long-term agricultural development in the area, provided proper well spacing and management are implemented. Other major environmental considerations for which precise hydrogeologic data are needed include: 1. Determination of the long-term yield available from properly constructed are producing artesian wells that will support a planned migration of population from the overcrowded Nile delta and flood plain areas. 2. Development of an effective management program and adequate staff to maintain groundwater production over an extended period of years. 3. The impact on climate caused by extensive irrigation in the oases of the Western Desert of Egypt. 4. Protection against water logging of soils from irrigation practices. 5. Protection against salinization of soils from irrigation practices. 6. Development of effective surface and subsurface drainage practices. 7. The impact of farming and pest control practices on the shallow groundwater of the oases. 8. Determination of the long-term development of the artesian water on the quality of the water from the aquifer systems in the Western Desert. This paper addresses items 1, 2, and 8. (Author's abstract)
W86-00554

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF SOIL EROSION ON SOYBEAN YIELDS AND CHARACTERISTICS OF CECIL-PACOLET SOILS,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
For primary bibliographic entry see Field 2J.
W86-00339

EFFECTS OF SOIL EROSION ON SOYBEAN PRODUCTION IN THE SOUTHERN PIEDMONT OF GEORGIA IN 1982,
Southern Piedmont Conservation Research Center, Watkinsville, GA.
A. W. White, R. R. Bruce, A. W. Thomas, G. W. Langdale, and H. R. Perkins.
Erosion - Productivity Investigations, 1982, Research Report No. IRC 060183, June, 1983. 21 p, 5 Fig, 5 Tab.

Descriptors: *Erosion, *Soil erosion, *Rainfall, *Soil water, *Soybeans, *Crop production, *Plant growth, *Crop yield, Potassium, Magnesium, Soil conservation, Phosphorus, Erosion control, Soil horizons, *Georgia.

Twenty-four fields within a 25-mile radius of Watkinsville, Georgia were planted in soybeans to evaluate the effects of erosion on crop growth and production. Three plots within each field were classified as slightly, moderately, and severely eroded. Pedon descriptions were made to 60-inches deep for each erosion level and rainfall and soil water were measured twice weekly from mid-July to the end of the growing season. Results showed that erosion reduced plant growth, yields, and stands. Soybean yields averaged 41.3, 28.1, and 19.8 bushels/acre for the slight, moderate, and severly eroded areas, respectively. Both stover and bean yields were reduced 52% on the severely eroded areas compared to the slightly eroded sites. Soil tests on plow layer samples indicated that severely eroded sites had markedly lower levels of P compared to slightly eroded soils, while K and Mg were lowest on slightly eroded areas. Although complete interpretation of results are not possible at this time, these preliminary data present overall evidence indicating marked effects of erosion on soybean yields on these soils based on current agricultural practices.
W86-00340

BIOMASS OF MACROPHYTES IN THE CHANNEL RUNNING THROUGH AGRICULTURAL AREAS,
Polish Academy of Sciences, Poznan. Dept. of Agrobiology and Forestry.
For primary bibliographic entry see Field 2H.
W86-00436

HUMAN ECOLOGY OF THE JAMES RIVER,
Richmond Univ., VA. Dept. of Biology.
J. W. Bishop.
Virginia Journal of Science, Vol. 36, No. 1, p 14-18, 1985. 1 Fig, 2 Tab, 15 Ref.

Descriptors: *Environmental effects, *Water quality, *James River, *Virginia, Water pollution sources, Hydrologic cycle, Dam effects, Climate, Water supply, Water resources development.

The James River is part of the hydrologic cycle which includes precipitation, evapotranspiration, surface runoff, and groundwater flow. People influence the supply of water both directly, as in the construction of reservoirs, and indirectly, as in the 'greenhouse effect', which affects climate, and therefore water supply. Following the James River from its headwaters on the Jackson River to its mouth demonstrates a pattern of increasing human involvement with the river, from farm ponds, to pumped storage electrical generation, to heavy industrial use. Water quality changes, generally for the worse, as the river progresses from relatively undeveloped to heavily developed areas. The river and the human population along its banks are interdependent. The population of the area, particularly at Richmond, has benefitted from the river, throughout history and can preserve the river for future use through employment of proper stewardship. (Rochester-IVI)
W86-00583

4D. Watershed Protection

BANK PROTECTION TECHNIQUES USING SPUR DIKES,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 8B.
W86-00311

LONG ISLAND SOUND THAMESVILLE TIDAL-FLOOD MANAGEMENT WATER RESOURCES STUDY, NORWICH, CONNECTICUT.
Corps of Engineers, Waltham, MA. New England Div.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA 120075. Reconnaissance Report, Stage 1, February 1981. 61 p. 7 Fig, 3 Tab, 4 Plates, 1 Append.

Descriptors: *Tidal floods, *Flood damage, *Floodproofing, *Flood protection, Thames River Basin, Connecticut, Planning, Economic aspects, Cost-benefit analysis, Interagency cooperation, Public policy.

The Thamesville area of Norwich, Connecticut, has the potential for severe flood damage from tides. This report identifies the problems, needs, and opportunities of the study area and the level of detail required to formulate any intermediate plans. Preliminary investigations have indicated that the Standard Project Hurricane (SPH) would cause enormous damage. An increase in future urbanization and encroachment on the flood plains can be expected to increase flood damages and magnify the problems the already exist. Protection of this area is feasible and would protect the immediate area from inundation. One environmental benefit would be the protection of the existing shoreline. Local interests consider protection against tidal flooding to be beneficial to the future development of the Thames River Basin and to the City of Norwich.
W86-00372

SEDIMENT LOSSES FROM CROPLAND FURROWS OF DIFFERENT GRADIENTS,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
For primary bibliographic entry see Field 2J.
W86-00467

SOIL LOSS FROM COTTON WITH CONSERVATION TILLAGE,
Science and Education Administration, Oxford, MS. Sedimentation Lab.
C. K. Mutchler, L. L. McDowell, and J. D. Greer.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 160-163 and 168, January/February, 1985. 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Soil erosion, *Soil loss, *Cotton, *Conservation tillage, Rainfall, Precipitation, Tillage, Erosion control,.

Erosion rates were documented and C-factors were calculated from conservation tillage for cotton grown on upland slopes. Three tillage systems for cotton were evaluated for erosion control effectiveness. Each of the three systems had two prior cropping histories. Soil loss ratios were computed for each crop stage to allow their use in the Universal Soil Loss Equation (USLE) for estimating soil loss from cotton. Soil loss from only the no-till cotton after no-till soybeans-wheat double-crop was below tolerable soil loss limits established by the Soil Conservation Service. Residue cover from cotton is less than from soybeans and corn, and the peculiar tap root system of the cotton plant contributes little to holding soil in place. The greatly beneficial effect of conservation tillage is seen in the comparison of plots conventionally tilled but with either an 11 year no-till or a conventional-till history. The no-till history apparently affected erosion because soil loss from conventional tillage was reduced by 47%, runoff reduced to 35% of the rainfall compared with 48% from long term conventional tillage, and seed cotton yield increased about 20%. (Baker-IVI)
W86-00497

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

GROUNDWATER MONITORING AND SAMPLE BIAS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 7B.
W86-00345

REFINERY WASTEWATER PRIORITY POLLUTANT STUDY - SAMPLE ANALYSIS AND EVALUATION OF DATA.
Radian Corp., McLean, VA.
American Petroleum Institute, Washington, DC., December 1981. 342 p. 9 Fig, 33 Tab, 5 Ref, 5 Append.

Descriptors: *Oil wastes, *Gas chromatography, *Mass spectrometry, Isotope dilution, Internal standard, Atomic absorption spectroscopy, Inductively coupled argon plasma spectroscopy, Variability, Effluents, Chemical analysis, Benzenes, Organic compounds, Chloroform.

This report discusses the bias and within-laboratory precision of several analytical methods in order to assess reliably the magnitude and day-to-day variation of pollutants concentrations in two refinery wastewaters. Organic pollutants were determined by comparing two gas chromatography-mass spectroscopy techniques: 'isotope dilution' vs 'internal standard'. Elemental pollutants were analyzed by atomic absorption (AA) and/or inductively coupled argon plasma spectroscopy (ICAP). Much of the variability in measurements of final effluent concentrations is due to variability associated with the analytical methods currently available to measure effluent concentrations at the part-per-billion level of such priority pollutants as methylene chloride, benzene, toluene, chloroform, and phthalates. The two refineries were remarkably similar with respect to the pollutants present in the influent and effluent samples and the concentrations of these pollutants. The use of the isotope dilution procedure offered no advantage over the internal standard procedure in terms of eliminating between-laboratory bias or improving within-laboratory precision. The ICAP and AA methods of elemental analysis are essentially equivalent for measuring chromium and zinc in refinery wastewaters.
W86-00378

CHARACTERIZATION OF INDUSTRIAL AQUEOUS DISCHARGES BY THE TLC/AMES' ASSAY,

Sentralinstitutt for Industriell Forskning, Oslo (Norway).
M. Moller, L. H. Landmark, A. Bjorseth, and L. Renberg.
Chemosphere, Vol. 13, No. 8, p 873-879, 1984. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Pollutant identification, *Ames test, *Thin layer chromatography, *Industrial wastes, *Textile mill wastes, Organic compounds, Mutagens, Wastewater analysis, Textile industry.

The in situ detection of mutagens by the thin layer chromatography/Ames' assay has been applied to aqueous discharges from a textile plant. The samples were fractionated in acid/neutral and basic fractions which subsequently were subject to the TLC/Ames' test. The waste water contains a number of chemicals which for example are used as carriers and additives in order to improve the process and the products. The results of the study demonstrate that even if the mutagenic activity decreases in the presence of S9, the individual components may have increased activity. This illustrates the importance of separating the chemicals with different mutagenic properties. The mutagenic response was significantly lower for the basic fraction than for the acid/neutral fraction. Testing of the basic fraction in the presence of S9 did not reveal any mutagenic response significantly above the level of spontaneous revertants, hence the S9-mixture has completely deactivated the mutagens in the basic fraction. These results demonstrate the convenience of characterizing mutagenic compounds by the TLC/Ames' test. By simple chemical fractionation, standardized TLC conditions and various bio-assay systems, valuable information may be obtained prior to detailed chemical characterization by gas chromatography/mass spectrometry or other advanced analytical techniques. (Baker-IVI)
W86-00389

ION-SELECTIVE ELECTRODES (ISE) - RESEARCH INTO THE POTENTIAL REGULATION AND APPLICATION IN ANALYSIS (IONENSELEKTIVE ELEKTRODEN (ISE) - UNTERSUCHUNGEN ZUR POTENTIALEINSTELLUNG UND ANWENDUNG IN DER ANALYTIK),

Technische Hochschule 'Carl Schorlemmer' Leuna-Merseburg (German D.R.).
U. P. Decker, and R. Geyer.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 1, p 19-27, 1984. 4 Fig, 4 Tab, 9 Ref.

Descriptors: *Ion-selective electrodes, *Water analysis, Water treatment, Iodides, Sulfides, Cyanides, Chlorides, Electrodes, Water quality control.

The necessity for the use of ion-selective electrodes in the water-control practice and for process control in water treatment processes is explained. After the description of the general construction principle of measuring systems for recording potential differences, special data and details are presented concerning the composition of the ion-selective electrodes. The principle of operation and the dependence on special conditions are described using theoretical considerations as examples. The following detection sensitivities with ion-selective electrodes (solid membranes) are given: iodide 0.01- 0.0000001; sulfide 0.01-0.000001; and cyanide 0.01-0.00001 mol/l. It may also be possible to detect chloride concentrations lower than 0.00001 mol/l with the aid of ion-selective electrodes on a solid membrane basis. (Author's abstract)
W86-00395

THIN-LAYER CHROMATOGRAPHIC DETERMINATION OF TRIAZIN HERBICIDES IN WATER (DUNNSCHICHTCHROMATOGRAPHISCHE BESTIMMUNG VON TRIAZIN-HERBIZIDEN IN WASSER),

Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
D. Lienig, B. Wiemer, and I. Zolfel.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 1, p 29-37, 1984. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Thin-layer chromatography, *Herbicides, *Triazine, Water analysis, Chromatography, Pollutant identification.

A description is given of thin-layer chromatographic determination of Triazine herbicides after chloroform extraction and detection with 0.1 N AgNO3 solution and irradiation by ultraviolet light. For simazine, Atrazine and Prometryne, the detection limits are at 0.05 micro-g. Disturbances can be avoided if two different mobile solvents are used and preliminary clean-up by thin-layer chromatography is done. The agreement of the Rf-values in two different mobile solvents with the Rf-values from known standard solutions is used as the criterion of identification. (Author's abstract)
W86-00396

POSSIBILITIES OF THE CORRELATION OF DIFFERENT WATER ANALYSIS METHODS (MOGLICHKEITEN DER KORRELATION UNTERSCHIEDLICHER WASSERANALYSENVERFAHREN),

Technische Hochschule 'Carl Schorlemmer' Leuna-Merseburg (German D.R.).
F. Winkler, B. Duwert, and H. Patecki.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 3, p 239-246, 1984. 6 Fig, 2 Tab, 14 Ref.

Descriptors: *Water analysis, *Wastewater treatment, Surfactants, Organic carbon, Chemical oxygen demand, Biochemical oxygen demand, Industrial wastewater.

The regressions and correlations between TOC, COD-Cr, COD-Mn, BOD5 and CHCl3-extract were investigated for model waters containing Prawozell W-ON 100 and Emulgator 30 as the most important tensides (synthetic surface active agents) as well as for the actual clarification plant influents of a chemical works. As expected, for the model waters in all cases highly significant regressions exist between the results of the different investigation methods. For the actual wastewater there can be demonstrated statistically secured connections with degrees of determination of 0.64-0.78 only for the pairs TOC - COD-Cr, BOD5 - COD-Cr, COD-Mn - COD-Cr and TOC - COD-Mn, due to the varying composition. The corresponding regression equations with their range of definition are given. They can contribute to rendering the acquisition of measured values more efficient and to control the wastewater treatment. (Author's abstract)
W86-00411

DETERMINATION OF SULFIDE IN WATER BY MEANS OF AN ION-SELECTIVE ELECTRODE (BESTIMMUNG VON SULFID IN WASSER MIT EINER IONENSELEKTIVEN ELEKTRODE),

Wasserwirtschaftsdirektion Saale-Werra, Halle (German D.R.).
H.-J. Neidhardt, and H. D. Steinleitner.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 3, p 247-253, 1984. 1 Fig, 17 Ref.

Descriptors: *Sulfides, *Ion-selective electrodes, *Water analysis, Potentiometry, Titration.

For the direct potentiometric measurement by means of a sulfide-selective solid-state membrane electrode (such as the reference electrode - a calomel electrode with a salt bridge filled with 1M KNO3-solution) a 25 ml sample is mixed with 25 ml sulfide-antioxidant buffer (0.2 M ascorbic acid in 2 M NaOH, Ag2S-saturated). Calibration is done with thioacetamide in the same buffer. This measuring arrangement determines sulfide concentrations of 0.0000015 to 0.001 M. If the buffer is added to the samples in the ratio of 1 + 1 during sampling, the sulfide content will be stabilized for at least 24 h. The measuring method and its calibration are compared with other methods of calibration with Na2S and potentiometric titration, idometric titration and photometric determination. The method developed proved to be very selective and requires a minimum expenditure of time. (Author's abstract)
W86-00412

THIN-LAYER CHROMATOGRAPHIC DETERMINATION OF MINERAL OIL IN WELL WATER (DUNNSCHICHTCHROMATOGRAPHISCHER NACHWEIS VON MINERALOL IN BRUNNENWASSER),

Bezirks-Hygieneinspektion und -Inst., Erfurt (German D.R.).
K. Machmerth.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 5, p 479-489, 1984. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Thin-layer chromatography, *Water analysis, *Mineral oil, *Well water, Pollutant identification, Drinking water, Chromatography.

A tabular survey is given from literature concerning seven extraction techniques, 14 thin-layer chromatographic detection techniques and 15 spray reagents. From the possibilities represented in this way, a newly composed method is described which can be carried out in any routine laboratory within one hour and has proved successful in situations of average of the drinking water supply. One l water is extracted with 25 ml CCl4, the extract is concentrated in the vacuum to 1 ml and chromatographed with n-hexane on a prefabricated foil. Detection is carried out with 10% methanolic molybdophosphoric acid. The detection limit is at 0.5 micro-g. (Author's abstract)
W86-00415

ANALYSIS OF CHLOROPHENOXYALKANE ACIDS AND CHLOROPHENOLS. PART 2: DETECTION OF CHLOROPHENOXYALKANE ACIDS AND CHLOROPHENOLS IN THE FISH BILE (ZUR ANALYTIK VON CHLORPHENOXYALKANSAUREN UND CHLORPHENOLEN. TEIL 2: NACHWEIS VON CHLORPHENOXYALKANSAUREN UND CHLORPHENOLEN IN DER FISCHGALLE),

Bezirksinstitut fuer Veterinarwesen Karl-Marx-Stadt (German D.R.).
K. Grahl, and H. Hermenau.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 5, p 491-497, 1984. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Chlorophenoxyalkane acids, *Chlorophenols, *Fish, *Chromatography, Pollutant identification, Herbicides, Thin-layer chromatography, Monitoring, Pesticide residues, 2,4-D, MCPA, MCPP, Dichlorophenols, Methylchlorophenols.

The bile liquid is preserved with ethanol and the protein is precipitated. Prefractionation is done by liquid-liquid extraction using chloroform and ethyl acetate. The extracts are separated on Florisil with column-chromatography and subsequent detection by thin-layer chromatography. To determine the identity of substances, the penta fluorobenzyl derivatives are prepared and chromatographed under the same conditions. Detection is carried out with the aid of ammoniacal silver nitrate reagent and ultraviolet irradiation. The highly polar conjugates of chlorophenoxyalkane acids and chlorophenols which are present in the bile are cracked by acid hydrolysis and then cleaned-up by re-extraction. Using this method, 2,4-D, MCPA, MCPP, 2,4-dichlorophenol and 2-methyl-4-chlorophenol were detected from Salmo gairdneri; 6-21 d after the application of the herbicides in the catchment area their concentration in the fish bile amounted to about 200 mg/l, 90% of them were conjugates. Thus, the biliary excretion of xenobiotic substances offers an important new aspect of biomonitoring with fish tests, especially in the range of subacute and chronic toxicity. (Author's abstract)
W86-00416

MODEL ECOSYSTEMS AS A TOOL IN FRESHWATER AND MARINE RESEARCH,

National Swedish Environment Protection Board, Solna.
A. Lundgren.
Archiv fur Hydrobiologie, Suppl. 70, No. 2, p 157-196, 1985. 9 Fig, 1 Tab, 144 Ref.

Descriptors: *Reviews, *Ecosystems, *Water pollution, *Model studies, Microcosms, Toxicity, Biodegradation, Biological magnification, Ecology, Food chains, Fate of pollutants, Water pollution effects.

This review is a survey of recent studies in aquatic ecotoxicology and experimental ecology, where model ecosystems were used as test systems and is an attempt to provide both theoretical and practical aspects on the strategy of model ecosystem design. Small synthetic laboratory microcosms are easily replicated and well suited for standardization. Two examples are described representing the model ecosystems and the model food chain. These microcosms are characterized by a very simplified structure and a reduced number of biotic and abiotic interactions and can not be regarded as models of any specific natural ecosystem. Experiments in small laboratory microcosms can, however, provide information on general ecosystem behavior and give quantitative indexes on biodegradability of chemical substances, ecological magnification, etc. If information on fate and effects of toxic chemicals on more specific natural ecosystems is needed, much more complex model ecosystems must be used. This is easiest done by isolating a part of a natural ecosystem. Different large-scale model ecosystems covering pelagic bags, benthos enclosures, enclosures of the profundal zone, combination enclosures with both benthic and pelagic communities and experimental ponds and lakes are described. The artefacts introduced by enclosure and scaling are discussed together with different ways to minimize their effects. The controversy between realism and replication is discussed and it is finally concluded that experiments in large-scale model ecosystems can provide valuable information on the fate and effects of pollutants in natural ecosystems. (Author's abstract)
W86-00526

BIOMONITORING OF THE CONTAMINATION OF WATER BY A SUBLETHAL CONCENTRATION OF PESTICIDES - A SYSTEM ANALYSIS APPROACH,

D.A.V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab.
S. R. Verma, and I. P. Tonk.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 4, p 399-409, 1984. 5 Tab, 32 Ref.

Descriptors: *Monitoring, *Bioassay, *Pesticides, *Systems analysis, Heteropneustes, Chlordane, Aldrin, Metasystox, Dichlorvos, Carbofuran, Sevin, Enzymes, Respiration.

Heteropneustes (Saccobranchus) fossilis (Pisces; Clariidae) was exposed to the biocides Chlordane, Aldrin, Metasystox, Dichlorvos, Carbofuran and Sevin for 30 d at a concentration of the 1/5 fraction of LC50;96h with daily exchange of the medium. At intervals of 5 d the respiration rate was determined for 1 h. In addition, after the end of tests 13 hematological parameters as well as the activities of the adenosine triphosphatases and acetylcholinesterase were determined in the liver, the kidney and the gills. During all exposures to biocides the respiration rate decreases significantly with the test time. At all exposures the blood concentrations of glucose, sodium- and chloride-ions show a significant increase, whereas the cholesterin content and the clotting time decrease significantly. The ATPase activity is significantly reduced only by Aldrin and Cholordane. A significant reduction of the acetylcholinesterase activity occurs in each of the three investigated tissues only for Metasystox and Dichlorvos and in the liver in addition also for Chlordane, Aldrin and Carbofuran. Therefore, the respiration rate and hematological criteria permit a general stress indication, enzymatic activities constitute a specific indication of individual groups of biocides, so that a systematic analysis of these three indication groups will probably provide a specific resultant statement in a biomonitoring system due to the specific inhibition pattern. (Author's abstract)
W86-00542

METHOD FOR DETERMINING AMMONIA NITROGEN IN WATERS (METHODE ZUR BESTIMMUNG DES AMMONIAKSTICKSTOFFES IN GEWASSERN),

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
I. Hoffmann, B. Nagy, and J. Schneider.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 6, p 645-651, 1984. 1 Fig, 9 Ref.

Descriptors: *Ammonia, *Water analysis, *Spectrophotometry, Nitrogen, Lake Balaton, Hungary.

For the spectrophotometrical determination of ammonia in surface water the reaction with hypochlorite and thymol in alkaline solution is used. Compared with other techniques, expenditure is low, the reagents are stable for a long period of time and the reaction is little dependent on external conditions. In 2 cm cuvettes there can be determined 0.05-0.5 mg/l ammonia nitrogen. Comparative investigations carried out at nine sites in the area of the lake Balaton have revealed concentrations of 0.2-0.7 mg/l ammonia nitrogen. (Author's abstract)
W86-00550

PHYSIOLOGICAL RESPONSES TO POLLUTION,

Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 5C.
W86-00597

STATE MUSSEL WATCH: TOXICS SURVEILLANCE IN CALIFORNIA,

California State Dept. of Fish and Game, Monterey.
M. Martin.
Marine Pollution Bulletin, Vol. 16, No. 4, p 140-146, April, 1985. 5 Fig, 5 Tab, 25 Ref. NOAA grant NA 81 AAHCZ 162.

Descriptors: *Monitoring, *Bioaccumulation, *Mussels, *California, Toxicity, Coastal waters, Trace metals, Polychlorinated biphenyls, Silver, DDE, Toxaphene, Endosulfan I, Pesticides, Lead, Copper, Zinc.

The California State Mussel Watch Program is described and an explanation is given as to where mussel watch findings have been used in regulatory or abatement action on trace toxic substances. Results of coastal monitoring of trace toxic substances are reported along with the biological effects measurements in synoptic studies of San Francisco Bay, chemical and biological monitoring at a major wastewater discharge in southern California, and the use of mussel watch data in regulation of toxics discharge to California marine and estuarine waters. Chromium, copper and zinc concentrations in mussels are consistently higher at stations near major southern California wastewater discharges. Lead levels were elevated in the southern California area. There was an unexpected hot spot found in Monterey Bay, central California, which caused a special intensive site study. Elevated concentrations of p,p'-DDE were found in the Southern California Bight. Mussels collected from South San Francisco Bay near Redwood Creek had high levels of silver in earlier investigations. In the 1983-84 study, a source for this elevated level was not found. Mussels collected from Moss Landing Harbor and Elkhorn Slough contained the highest concentration of toxaphene and endosulfan I. At the state level, California uses the Water Quality Control Plan for Ocean Waters of California to regulate waste discharge to ocean waters. The United States National Oceanic and Atmospheric Administration recently initiated a program called the National Status and Trends Program in response to a general concern about the potential for bioaccumulation of synthetic organic pollutants in marine/estuarine areas of the US. The NOAA Status and Trends program contains a mussel watch component to produce data that will be collected, and be incorporated in reports of pollutant conditions in the nation's marine waters. (Baker-IVI)
W86-00598

5B. Sources Of Pollution

CALCIUM CHLORIDE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.

Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W86-00309

FERRIC CHLORIDE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.

Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W86-00310

CHLORINE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.

Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W86-00319

COASTAL MARINE RESOURCES INVENTORY, 1983: PEMAQUID POINT TO SPRUCE HEAD,

Maine State Dept. of Marine Resources, West Boothbay Harbor. Marine Resources Lab.
For primary bibliographic entry see Field 5C.
W86-00322

SOURCES, CHEMISTRY, FATE, AND EFFECTS OF CHROMIUM IN AQUATIC ENVIRONMENTS.

Ecological Analysts, Inc., Sparks, MD.
American Petroleum Institute, Washington, DC., November, 1981. 191 p. 22 Tab, 210 Ref.

Descriptors: *Reviews, *Chromium, *Fate of pollutants, *Water pollution sources, *Water pollution effects, *Toxicity, *Water quality standards, *Pollutant identification, Heavy metals, Metals, Bioaccumulation, Uptake, Nonpoint pollution sources, Aquatic animals, Aquatic plants, Industrial wastes.

A comprehensive body of information on detection, chemistry and fate, principal sources, and biological effects of Cr in surface waters is present-

ed in context with regulatory applications for the control of Cr discharges. Analytical methods for Cr determination are described and evaluated. The chemistry of Cr in water is discussed as it relates to biological availability. The effects of hydrolysis, speciation, precipitation, adsorption, and bioaccumulation in determining the fate of Cr are discussed. The most recent data available on industrial and publicly owned treatment-works point-source contributions of Cr to surface waters are assessed and estimates are provided. Anthropogenic nonpoint sources are also mentioned. The effects of Cr ingestion on human health and its role in human nutrition are presented. A comprehensive review of the effects of Cr on aquatic organisms includes data on acute and chronic toxicity and bioaccumulation. Biotic and abiotic factors which affect Cr toxicity and uptake are discussed. A review of federal Cr criteria and the technical rationale behind their development is presented along with a listing of current state water quality criteria and standards. The existing regulatory framework concerning the discharge of Cr in industrial point source effluents is discussed with emphasis on how regulatory agencies can use aquatic toxicity data to derive water quality criteria.
W86-00344

VERIFICATION AND TRANSFER OF THERMAL POLLUTION MODEL; VOLUME IV: USER'S MANUAL FOR THREE-DIMENSIONAL RIGID-LID MODEL,

Miami Univ., Coral Gables, FL. Dept. of Mechanical Engineering.
S. S. Lee, S. Sengupta, E. V. Nwadike, and S. K. Sinha.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116103. Report EPA-600/7-82-037d, May 1982. 145 p. 8 Fig, 6 Tab, 4 Ref, 2 Append. Contract/Grant No. NAS 10-9410.

Descriptors: *Computer models, *Thermal pollution, *Mathematical models, Lake basins, Lakes, Computer programs, Path of pollutants.

The three-dimensional rigid-lid model was developed by the thermal pollution group at the University of Miami and verified for accuracy at Lake Keowee, South Carolina. The model results were fairly accurate in all the verification runs. The model is intended to be used for hydrothermal predictions of closed basins subjected to a heated discharge together with various other inflows and outflows. This manual has been written to enable any user to be able to apply it without difficulty. Derivation of the governing equations and various other details have been omitted.
W86-00346

TRANSPORT, FATE AND EFFECTS OF ENERGY-RELATED POLLUTANTS: EVALUATION OF SURFACE AND GROUNDWATERS; APPENDIX 1: PRELIMINARY LISTING OF SENSITIVE SURFACE WATERS,

Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
G. R. Hendrey, H. C. Thode, and N. Gmur.
Available from the National Technical Information Service, Springfield, VA 22161 as No. DE82016614. Second Progress Report, September 1981. BNL-51473, Volume 2. 130 p. 31 Fig, 17 Tab, 18 Ref, 2 Append. Contract/Grant No. DE-AC02-76CH00016.

Descriptors: *Acidic water, *Alkalinity, *Water quality, *Acid rain, Conductivity, Hydrogen ion concentrations, Water pollution effects, Groundwater, Surface Water.

The sensitivity of freshwaters of the eastern United States to acidification was evaluated by identifying and mapping specific sites at which low alkalinity or pH may exist, or at which there has been an increase in acidity or decrease in alkalinity. Efforts have been concentrated on the acquisition of new water quality data for inclusion in the Acidification Chemistry Information Database (ACID), on expanding the list of chemical variables in the database, on devising statistical methods for examining and improving the quality of the component data sets, and on analyses of temporal trends in water quality for selected states. Analyses of seasonal patterns in chemical variables are in progress as part of the temporal trend analysis. So far, > 3,500 stations have been provisionally identified as sensitive to acidification (alkalinity < or = 0.1 meq/liter. Data in ACID also indicate that 669 stations have statistically significant long-term decreases in alkalinity (further verification is required). State-by-state maps locating these stations are presented. This progress report also describes the current contents and status of ACID, presents results of searches for erroneous data, and describes ongoing and planned quality control procedures.
W86-00348

ENVIRONMENTAL RISK ASSESSMENT: THE POTENTIAL ROLE OF MICROBIAL EFFECTS TESTING,

Environmental Protection Agency. Washington, DC. Office of Pesticides and Toxic Substances.
For primary bibliographic entry see Field 5C.
W86-00353

CHLORINATED PHENOLS AS CONTAMINANTS OF SOIL AND WATER IN THE VICINITY OF TWO FINNISH SAWMILLS,

Helsinki Univ. (Finland). Dept. of General Microbiology.
R. Valo, V. Kitunen, M. Salkinoja-Salonen, and S. Raisanen.
Chemosphere, Vol. 13, No. 8, p 835-844, 1984. 3 Fig, 5 Tab, 17 Ref.

Descriptors: *Saw mills, *Fungicides, *Water pollution sources, *Chlorophenols, Phenols, Surface water, Groundwater pollution, Leaching, Organic compounds, Fate of pollutants, Finland.

All the wood exporting sawmills in Finland use fungicide for preserving freshly sawn timber and lumber against losses during storage and shipment. The results of a study on the occurrence of chlorinated phenols at and around two Finnish sawmills, both of which used a typical wood preserving method, are reported. One mill (A) had been using chlorophenolic wood preservative for 2 seasons and mill B for 20 seasons. Mill A used a preserving method in which the lumber was not placed in a trickling basin after dipping. Mill B had a trickling basin for treated lumber. Soil around the basin was heavily contaminated. At mill A concentration of 70 mg chlorophenols/kg soil was found near the treatment basin while the figure for the same area at mill B was 30 mg/kg. The soil in the storage area for preserved wood contained up to 6 mg/kg at A and 1 mg/kg at B. The vertical distribution of chlorophenols in the soil was uneven, indicating that chlorophenols accumulate in certain layers more than in others. The main components of the wood preserving solution, 2,4,6-TCP, 2,3,4,6-TeCP and PCP, were usually the most abundant in soil at most sites. Polychlorinated phenols are thus stable in the sawmill surroundings. Groundwater samples taken from the vicinity of mill A were found to contain from 1.6 to over 20,000 micro-g of chlorophenols per liter, while the concentration detected in a nearby lake was only 40 ng/l. Contamination of household wells by the direct flow of groundwater from the dipping basin is improbable, because the water level in those wells was above the dipping basin. Leaching of chlorophenols from the storage area or transport through the air are more probable ways for the contaminants to spread. (Baker-IVI)
W86-00387

TETRACHLORODIBENZO-P-DIOXINS AND TETRACHLORODIBENZOFURANS IN ATLANTIC COAST STRIPED BASS AND IN HUDSON RIVER FISH, WATERFOWL AND SEDIMENTS,

New York State Dept. of Health, Albany. Div. of Labs. and Research.
P. O'Keefe, D. Hilker, C. Meyer, K. Aldous, and L. Shane.
Chemosphere, Vol. 13, No. 8, p 849-860, 1984. 3 Tab, 26 Ref.

Descriptors: *Tetrachlorodibenzo-p-dioxin, *Tetrachlorodibenzofuran, *Bass, *Fish, *Hudson River, *New York, Dioxins, Water pollution sources, Chlorophenols, Polychlorinated biphenyls, Chlorinated hydrocarbons.

The extent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) and 2,3,7,8-tetrachlroodibenzofuran (2,3,7,8-TCDF) contamination of various populations of Atlantic Coast striped bass including fish from the Hudson River was examined. There was no evidence of contamination by 2,3,7,8-TCDD or 2,3,7,8-TCDF in samples of brook trout from a hatchery, with limits of detection varying from 0.6 to 2.2 ppt. Analytical results showed the 2,3,7,8-TCDD concentration in the striped bass from the Hudson River and its estuary to be significantly higher than the concentrations present in striped bass from Chesapeake Bay and Rhode Island coastal waters. A similar result was obtained from 2,3,7,8-TCDF, although the level of significance was reduced. The finding that concentrations of 2,3,7,8-TCDD greater than 5 ppt are confined to fish from the Hudson River should be considered in relation to the life cycle of the species. An effective program to control 2,3,7,8-TCDD/2,3,7,8-TCDF in the Hudson River striped bass population will require a knowledge of the sources of the contaminants to the river. Tentative findings suggest that these contaminants do not appear to be associated with a source in the upper Hudson River such as those previously described in polychlorinated biphenyl discharges. The presence of 2,3,7,8-TCDD as the only TCDD isomer in the sediment and fish suggests that the source of contamination is a chemical such as trichlorophenol where 2,3,7,8-TCDD is the only PCDD isomer which can be readily detected. Polychlorinated biphenyls are a possible source for 2,3,7,8-TCDF, with the documented evidence for preferential bioaccumulation of 2,3,7,8 substituted isomers accounting for the absence form the fish tissue of the other TCDF isomers found in the sediment. The similar concentrations in the fish over a 2 year period suggests that there is a constant exposure level in the river, but evaluation of sources requires additional data. (Baker-IVI)
W86-00388

DISTRIBUTION AND RATE OF DISAPPEARANCE OF FLUORENE IN POND ECOSYSTEMS,

Columbia National Fisheries Research Lab., MO.
T. P. Boyle, S. E. Finger, J. D. Petty, L. M. Smith, and J. N. Huckins.
Chemosphere, Vol. 13, No. 9, p 997-1008, 1984. 3 Fig, 2 Tab, 35 Ref.

Descriptors: *Fluorene, *Ponds, *Fate of pollutants, Distribution, Evaporation, Degradation, Sediments, Macrophytes, Ecosystems, Trophic level, Phytoplankton, Dissolved oxygen.

The environmental fate of fluorene applied at different concentrations to various experimental pond ecosystems was examined with emphasis on estimating the role of several physical, chemical, and biological factors in determining the relative distribution of fluorene in aquatic ecosystems and examining the use of the chemical parameters of fluorene to predict relative rates of its disappearance. Fluorene rapidly disappears from freshwater pond ecosystems. This disappearance is considered to have occurred in two modes: evaporation and sublimation from the surface of the pond, and degradation of the parent compound. Most of the fluorene applied to the ponds was not accounted for by the measurements taken in water, mud and plants. The trophic state of a lentic ecosystem may affect a number of environmental variables that also play important roles in determining the persistence of a chemical contaminant. Two factors connected with the level of productivity were significantly associated with the rate of fluorene disappearance: the density of phytoplankton as indicated by chlorophyll a, and the dissolved oxygen concentration at dawn. The rate of disappearance of fluorene was also linked to differences in productivity. Where the mean level of chlorophyll a was high, the rate of fluorene disappearance was also high; when the oxygen concentration over the nocturnal period, as

indicated by an early morning measurement, dropped low enough, fluorene degradation was retarded. The results of this study imply that eutrophic lakes and ponds are better able to degrade organic compounds such as fluorene than are oligotrophic systems. Moreover, aquatic environments with low dissolved oxygen concentrations may potentially have lower degradation potentials. (Baker-IVI)
W86-00391

CASE OF POLYCHLORINATED BIPHENYL CONTAMINATION OF WATER AND SEDIMENT IN THE SLOVENIAN KARST REGION (YUGOSLAVIA),

Maribor Inst. of Public Health (Yugoslavia).
S. Brumen, M. Medved, E. Voncina, and J. Jan.
Chemosphere, Vol. 13, No. 11, p 1243-1246, 1984. 2 Fig, 8 Ref.

Descriptors: *Polychlorinated biphenyls, *Fate of pollutants, *Karst hydrology, *Slovenia, *Yugoslavia, Industrial wastes, Waste disposal, Sediments, Water analysis, Chlorinated hydrocarbons,.

An incident is described in which polychlorinated biphenyls (PCBs) from an electro-industrial plant waste dump draining into groundwater channels in karst terrain have contaminated a potable water source. PCB composition data were obtained using quadropole GC-MS and capillary GC. The average level of PCBs determined in water was 0.3 micro-g/l and in sediment was 55 micro-g/g. From the negligible decline of degradable PCBs relative to the more persistent components, the impression is given that PCBs in a karst environment are rather stable. The decline of some lower chlorinated components in the PCB profile of sediment is more pronounced and could be explained as due to some physico-chemical effects such as lower incorporation into the sediment, transportation to air release to water, and higher susceptibility to degradation. (Baker-IVI)
W86-00392

COPPER, ZINC, CADMIUM, AND LEAD IN SCALLOPS (PLACOPECTEN MAGELLANICUS),

Department of Fisheries and Oceans, St. Andrews (New Brunswick).
S. Ray, M. Woodside, V. E. Jerome, and H. Akagi.
Chemosphere, Vol. 13, No. 11, p 1247-1254, 1984. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Scallops, *Bays, *Georges Bank, *Browns Bank, *Bay of Fundy, *Copper, *Zinc, *Cadmium, *Lead, Metals, Fate of pollutants, Fish.

The total body burden of Cd for similar sized scallops from Georges and Browns Banks ranged from 135 to 245 micro-g compared with only 71 micro-g for scallops from the Bay of Fundy. The concentrations of Cd in individual tissues in all cases were also higher than those for Bay of Fundy scallops. Such differences did not occur for Cu, Zn, and Pb. The high body burden of Cd in scallops from Georges and Browns Banks far away from any known source of anthropogenic input is surprising and suggests a natural origin. The observation that Cd concentrations in medium sized animals are significantly lower than in either smaller or large animals has not been reported previously and possible physiological factors controlling it should be examined. It is not known whether high levels of the metal in the various tissues cause any physiological damage to the scallop but complete absence of large scallops from Browns Bank and their relative scarcity from George Bank may be related to the high body burden of Cd. There is also the possibility that the absence of large scallops may be related to the intense fishing in the area. (Baker-IVI)
W86-00393

INTENSIVE CARP REARING IN LAKES AND EUTROPHICATION (KARPFENINTENSIVBEWIRTSCHAFTUNG VON SEEN UND EUTROPHIERUNG),

Bezirks-Hygieneinspektion und -Inst., Potsdam (German D.R.).
L. Kalbe.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 2, p 145-152, 1984. 5 Tab, 25 Ref.

Descriptors: *Carp, *Aquaculture, *Eutrophication, Phytoplankton, Zooplankton, Lake sediments, Chlorophyll, Primary productivity, Cycling nutrients, Aquatic plants, Galenbeck Lake.

In Galenbeck lake, a shallow lake covering 700 ha and having a nutrient load of 0.23 g/sq ma P and 4.3 g/sq ma N, in 1965 a stock of 500 carp/ha was established and fed with grain. This stock of carp resulted in a considerable disturbance and redeposition of the soft lime sediments; the rich submersed vegetation disappeared and the phytoplankton reached a maxima of 885,420 cells/ml, whereas the zooplankton reached only 4530 ind./l. The chlorophyll content increased to 464 mg/cu m, and the depth of visibility decreased to 10 cm. The total planktonic primary production is estimated at at least 500 g/sq ma C. These changes are regarded as eutrophication, caused mainly by internal fertilization by an intensified recirculation of nutrients from the sediment, but also by the fertilization which is connected with feeding. The fish rearing ceased and the stock of carp was fished off; in 1970 a restoration of the lake began, and in 1974 the lake again reached its original state as a clear-water lake with an abundant population of macrophytes, supported by the P-retention in an upstream storage reservoir for spray-irrigation water. (Author's abstract)
W86-00406

PROBLEM OF INTENSIVE CARP REARING IN LAKES AND EUTROPHICATION (ZUR FRAGE DER KARPFENINTENSIVBEWIRTSCHAFTUNG VON SEEN UND EUTROPHIERUNG),

Institut fuer Binnenfischerei, Berlin (German D.R.).
D. Barthelmes.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 2, p 153-161, 1984. 24 Ref.

Descriptors: *Carp, *Aquaculture, *Eutrophication, Macrophytes, Aquatic plants, Periphyton, Phytoplankton, Lake sediments, Galenbeck Lake.

Normally, carp rearing at medium densities is connected with the promotion of daphnia and filtration effects up to 'clear-water states'. Because of the reduction of submerged plants and of the periphyton, this form of carp rearing should be possible in eutrophic shallow lakes with a slight nutrient introduction without any considerable eutrophication. Due to the deterioration of the light climate by re-suspension of the sediment, even reductions in primary production are possible. In the case of Galenbeck Lake a drastic reduction of submerged macrophytes occurred in connection with an increased development of plankton, only general estimations being available of the shares of macrophytes and phytoplankton in the overall production. The phytoplankton increase is perhaps caused by the absence of filtering zooplankton due to an insufficient reduction of the indigenous fish stocks. In Galenbeck Lake, the structural changes in the ecosystem were due both to the high degree of re-suspension of the very mobile lime sediment and the absence of hard bottom areas, which made the total reduction of the macroflora possible. (Author's abstract)
W86-00407

SIMULATION OF NITRATE DEGRADATION IN GROUNDWATER (SIMULATION DES NITRATABBAUS IM GRUNDWASSER),

Institut fuer Binnenfischerei, Berlin (German D.R.).
M. Schwan, D. Kramer, and C. Gericke.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 2, p 163-171, 1984. 2 Tab, 11 Ref.

Descriptors: *Groundwater pollution, *Nitrates, *Degradation, *Simulation, Groundwater recharge, Wastewater disposal, Diffusion, Convection, Kinetics, Differential equations, Model studies.

Ten reaction vessels containing 1 cu m were used as the experimental arrangement. They were filled with coarse sand or fine gravel and installed 60 cm below the floor. The pore volume (water saturation) was 227-260 l. Anaerobic conditions were established by the addition of 6 g glucose at storage. The reactors were given tap water with 50 and 200 mg/l NO-3 from KNO3 in such a way that a volumetric rate of flow of 0.2, 0.4 and 0.8 l/d was created. The volumetric rates of flow corresponded to the natural recharge of groundwater, the recharge of groundwater under the conditions of irrigation and the conditions of an intensive wastewater ground treatment. In the effluent from the reaction vessels the nitrate concentration was determined every month. It was stationary from the 7th to the 55th month after the beginning of the experiment. The experiments are evaluated by means of a model which takes into account the diffusion, convection and kinetics of the nitrate degradation according to Michaelis-Menten. A simple method for solving homogeneous non-linear differential equations of the second order is proposed. The experimental and model results show a good agreement and prove the very slow nitrate degradation in the groundwater with kM = 210 mg/l, v max = 1.5 mg/l.d or k1 = 0.005/d. (Author's abstract)
W86-00408

INDICATOR BACTERIA IN WATER AND STREAM SEDIMENTS NEAR THE SNOWY RANGE IN SOUTHERN WYOMING,

Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
H. L. Gray, and J. C. Adams.
Water, Air, and Soil Pollution, Vol. 25, No. 2, p 133-144, June, 1985. 4 Fig, 3 Tab, 21 Ref.

Descriptors: *Bioindicators, *Bacteria, *Stream pollution, *Sediments, *Wyoming, Fecal coliforms, Fecal streptococci, Water pollution sources, Coliforms, Pollutant identification, Grazing, Recreation.

Water samples were taken at eight pools in streams in the Nash Fork watershed after snowmelt in the summer of 1980. The watershed is below the Snowy Range escarpment, and principal land uses include skiing and other winter sports, sheep and cattle grazing, camping and fishing, and summer homes. Water taken before and after disturbing stream bottom sediment were analyzed for fecal coliforms (FC) and fecal streptococci (FS). FC counts in undisturbed pool influent water ranged from 0 to 30 colonies per 100 mL of water. The FC densities were less than 1 colony per 100 mL of water in only 10 of 24 samples taken during the 3 month study. The streamwater was questionable for drinking without treatment, but was suitable for all other recreational uses. The main sources of FC were sheep and cattle. Stream sediment was not a source. Study sites most impacted by recreation use had low FC densities. Only one site, crossed by the band of 1000 sheep in August, was seriously degraded by fecal contamination. Within a period of one month, and in the absence of continued fecal contamination, bacterial counts on the stream moss samples decreased from 2500 GC per g of wet moss in August to 5 FC in September. FS counts in the undisturbed pool influent water ranged from 6 to 590 colonies per 100 mL of water and were also highest at sites most impacted by sheep and cattle. FS densities ranged from 1.1 to 19.5 times greater in the pool effluent than in the influent water. The sediment appeared to have harbored FS bacteria that had survived and/or multiplied. No significant evidence was found for major long-term, cumulative increases in bacterial densities in stream water and bottom sediment due to past and present sheep and cattle grazing and recreation use. The levels of FC and FS densities associated with present land uses will likely remain relatively constant from year to year because of long winters, annual streamflow replenishment from the melting snowpack, and scouring of streams as a result of high spring and summer runoff. (Baker-IVI)
W86-00428

SEDIMENT ACID NEUTRALIZATION IN SOFTWATER LAKES,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 2H.
W86-00432

IMPACT OF THE SILVER CARP (HYPOPHTHALMICHTHYS MOLITRIX VAL.) ON THE ECOSYSTEM OF CARP PONDS,

Instytut Rybactwa Srodladowego, Piaseczno (Poland). Dept. of Pond Management.
W. Piotrowska-Opuszynska.
Ekologia Polska, Vol. 32, No. 2, p 307-339, 1984. 10 Fig, 5 Tab, 58 Ref.

Descriptors: *Fish farming, *Silver carp, *Fish ponds, *Physicochemical properties, Aquaculture, Dissolved oxygen, Chlorophyll, Carp, Primary productivity, Phytoplankton.

The effect of the silver carp on the physico-chemical conditions of the carp pond habitat was studied. A determination was also made of the mechanisms via which it modified the habitat. The presence of the silver carp brought about significant changes in the physico-chemical and biocoenotic conditions of the ponds. In all cases, an increase was found of chlorophyll content in the water and a higher primary production, relative to the control ponds stocked with carp alone. The loading of the water with organic matter increased, this being indicated by the amount of nitrogen, phosphorus and organic carbon. The level of mineral compounds was lower. As densities of silver carp increased, the level of oxygen in the water rose. With silver carp larvae, the content of chlorophyll in the water was higher, and so was the primary production, the amount of oxygen was lower than in the control ponds. This is attributed to the lack of organic matter elimination by the silver carp larvae. The silver carp caused an intensive growth of the phytoplankton via a complex effect on the ecosystem. Although it did not fulfill the original hopes concerning the control of water eutrophication, the silver carp played a positive role as a factor taking part in the control of the living conditions of the fish in the ponds. It gave an additional piscicultural production due to a better utilization of the food resources of the habitat. It may be considered a species desirable in fish farming, especially in carp ponds. (Baker-IVI)
W86-00439

SEDIMENT COMPOSITION FOR NONPOINT SOURCE POLLUTION ANALYSES,

Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
G. R. Foster, R. A. Young, and W. H. Neibling.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 133-139 and 146, January/February, 1985. 5 Fig, 2 Tab, 23 Ref. DOE contract W-7405-ENG.36.

Descriptors: *Nonpoint water pollution sources, *Pollutant analysis, *Path of pollutants, *Sedimentation, Soil properties, Clay, Silt, Aggregates, Sand, Mathematical equations, Model studies.

A report is offered of the development of relationships for sediment distributions and the composition of aggregates near the point of detachment as a function of the most basic soil property, primary particle distribution in the matrix soil. Data from 28 soils were analyzed to develop equations that describe sediment characteristics, including distribution of particle classes and composition of the particle classes as a function of the primary particle distribution in the matrix soil. Important sediment particle classes identified were primary clay, primary silt, and primary sand and small aggregate, and large aggregate. The equations calculate the fractions of these classes in the sediment at its point of detachment, the clay and silt fractions in the small aggregates class, and the clay, silt, and sand fractions in the large aggregate class. The equations derived for estimating the composition of the particle classes can be used, together with specific surface areas, to compute enrichment ratios for evaluating the change in contaminant concentration of sediment when deposition changes the composition of the sediment. The equations describe sediment characteristics at the point of detachment and not at the edge of fields. They are intended for use in erosion/sediment yield models, for field-sized areas, that route sediment by particle classes to compute changes in sediment characteristics caused by transport and deposition between the point of detachment and edge of field. (Baker-IVI)
W86-00493

RELATIONSHIP OF CELLULAR PHOSPHORUS IN THE CYANOBACTERIUM NODULARIA TO PHOSPHORUS AVAILABILITY IN THE PEEL-HARVEY ESTUARINE SYSTEM,

Western Australia Univ., Nederlands. Inst. of Agriculture.
For primary bibliographic entry see Field 2L.
W86-00531

TRANSFORMATIONS OF SUBSTANCES IN AQUATIC SYSTEMS AND THEIR HYGIENIC EVALUATION (STOFFTRANSFORMATIONEN IN AQUATISCHEN SYSTEMEN UND IHRE HYGIENISCHE BEWERTUNG),

Institute of General and Municipal Hygiene, Moscow (USSR).
G. N. Krassovski, A. A. Korolew, S. I. Scholdakowa, R. Koch, and H.-J. Dobberkau.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 4, p 363-368, 1984. 2 Tab.

Descriptors: *Chemical reactions, *Fate of pollutants, *Toxicity, Bioaccumulation, Water treatment, Drinking water, Carcinogens, Mutagens, Teratogens, Organic compounds, Oxidants.

Chemical substances can be transformed under the influence of physical/chemical and/or biochemical active factors. By this, the ecotoxicological and hygiene-toxicological properties and effects of the substances are changed also with respect to toxicity, late effects (carcinogenetic, mutagenic, teratogenetic ones) as well as the bio- and geo-accumulation behavior. Such transformations occur also during water treatment, and therefore also the properties and effects of the transformation products have to be taken into account for determining the limit values for pollutants in raw water for the production of drinking water. Since frequently one has incompletely known transformation products or mixtures of substances, a coefficient of hazard is suggested for the evaluation. It is the quotient of the threshold concentrations of the initial substance and of the transformation products for the different (organoleptic, toxic, carcinogenic, teratogenetic etc.) effects. For several organic substances it is demonstrated that the transformation products can be regarded less toxic compared with the initial substance. Strong oxidants, however, cause an increased danger in many cases. (Author's abstract)
W86-00538

RELATIONSHIP BETWEEN ORGANIC CARBON AND CHEMICAL OXYGEN DEMAND,

Ceskoslovenska Akademie Ved, Prague. Hydrobiologicka Lab.
For primary bibliographic entry see Field 2K.
W86-00540

MODEL OF A BACTERIAL CULTURE UTILIZING A TOXIC SUBSTRATE IN CONTINUOUS FLOW CONDITIONS,

Bulgarian Academy of Sciences, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika.
S. E. Teodorova, and I. K. Sivriev.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 6, p 637-643, 1984. 3 Fig, 12 Ref.

Descriptors: *Bacteria, *Toxic substances, Mathematical equations, Fate of pollutants, Biological wastewater treatment, Enzymes, Bacterial decomposition.

A model for the population growth of a bacterial culture growing by use of a single toxic substrate is presented and discussed. The model for an enzymatic reaction with one substrate, which simultaneously acts on the enzyme as an irreversible inhibitor, is: S + E (which leads irreversibly to E' with rate constant k sub 3) leads reversibly to C (k sub 1 = forward rate constant, k sub -1 = backward rate constant), which in turn leads irreversibly to P + E, with rate constant k sub 2, in which S = substrate, E = enzyme, E' = inactivated enzyme, and P = product. The equation for the stationary state has the form dc/dt = 0 = k sub 1(s-c) (e-c-e') - k sub -1(c) - k sub 3 (s(2)) - k sub 2 (c), in which the small letters are the corresponding concentrations. It is assumed that the velocity of inactivation of the enzyme is proportional to the square of the concentration of the substrate: de'/dt = k sub 3 (s(2)). To use the equation in the stationary state, it is suggested that the concentration of the inactivated enzyme is negligibly small compared to the concentration of active enzyme. The relative velocity of growth of the bacterial culture, the growth of the bacterial culture that degrades substrate S, the influence of the concentration of toxic substrate on the relative velocity of biomass synthesis may be obtained from this model. The model applies in the investigation of the stability of the biological processes employed for the degradation of different toxic substances and for the explanation of the specific mechanism of the inhibiting action of the toxic substances on the various microorganisms. The model may be used for selecting optimum conditions and parameters for biodestruction of noxious substances in water pools and purifiers. (Rochester-IVI)
W86-00549

ACID MINE DRAINAGE CONTAMINATES GROUNDWATER OF A TENNESSEE WATERSHED,

Tennessee Cooperative Fishery Research Unit, Cookeville.
C. J. O'Bara, and R. D. Estes.
Environmental Geology and Water Science, Vol. 7, No. 3, p 159-161, 1985. 2 Tab, 7 Ref.

Descriptors: *Groundwater pollution, *Acid mine drainage, *Springs, *Tennessee, Water pollution sources, Surface mines, Abandoned mines, Acidity, Hydrogen ion concentration, Sulfates, Iron, Manganese, Elevation, Hydrogeology.

Surface mining began in the West Fork of the Obey River Watershed, Tennessee, during the early 1900s and ceased in the 1950s. Water samples were collected from 18 natural springs within the West Fork of the Obey River watershed to determine if groundwater was adversely affected by runoff from abandoned surface coal mines. Six springs were found to be affected severely and deemed unfit as a source of potable water. The degraded springs were located on the Cumberland Plateau and along the western escarpment of the plateau. Generally, water of affected springs had pH less than 6.0, total alkalinity less than total acidity, and high sulfate, iron, and manganese concentrations. Water quality of the remaining springs was essentially unaffected. Three major factors were identified as possible causes in determining the quality of groundwater in the watershed. The proximity of a spring to an abandoned mine was considered important in determining the quality of the water. A second factor was the elevation at the outflow of a spring, which can be associated with different aquifers. The third factor was the geological characteristics of the strata surrounding the spring. (Moore-IVI)
W86-00555

DISTRIBUTION AND BACKGROUND OF TOTAL MERCURY IN SEDIMENTS FROM BOHAI BAY,

National Bureau of Oceanography, Hangzhau (China). Second Inst. of Oceanography.
X. Zhang, and X. Liao.
Marine Sciences, Vol. 9, No. 1, p 32-37, January, 1985. 9 Fig, 2 Tab.

Descriptors: *Mercury, *Sediments, *Bohai Bay, *China (Peoples Republic), Heavy metals, Water pollution sources, Estuaries, Bays.

One hundred twenty-one samples of the surface sediments were taken from Bohai Bay (Peoples Republic of China) in 1978-1980; their total mercury values ranged from 0.005 to 0.560 ppm, with an average value of 0.065 ppm. The higher levels (0.05 ppm) were in the west part of the Bay adjacent to the estuary of Beitang. The contents of mercury decreased rapidly with increasing distance from the estuary. The area of Bohai Bay polluted by mercury accounts for 5%. According to the data from 7 cores, the background of total mercury was confirmed to be 0.05 ppm. (Author's abstract)
W86-00579

PROCESSES OF BIOACCUMULATION: THE IMPORTANCE OF CHEMICAL SPECIATION,

Institute for Marine Environmental Research, Plymouth (England).
A. Nelson, and P. Donkin.
Marine Pollution Bulletin, Vol. 16, No. 4, p 164-169, April, 1985. 3 Fig, 45 Ref.

Descriptors: *Chemical speciation, *Marine pollution, *Bioaccumulation, Heavy metals, Organic compounds, Mercury, Lead, Bioassay, Bioavailability.

The realization of the importance of chemical speciation in marine pollution studies has brought chemists and biologists together such that not only can the chemical and geochemical behavior of a pollutant be evaluated but this can be linked to the extent of toxicological effect of the predominant species of the contaminant. This combination of chemical and biological understanding is an essential prerequisite of predictive modelling of the biological impact of pollutants. The chemical cycling of mercury in the environment is used as an example of the concept of chemical speciation. The primary barrier between an organism and its environment is the cell membrane. The toxicity of many agents is related therefore to their lipid solubility and thus to their ability to pass through the lipoprotein membrane of the cells. Since the lipid-soluble species tend to be retained in the membranes and fatty tissues of organisms, bioavailable compounds also are very often accumulated. Various carrier species in the membrane serve to facilitate the passage of molecules and ions. Also the organism/water boundary represents an interface where the surfactant properties of the transported moiety will determine to some extent its bioavailability. Experimental investigations of bioavailability are reported for heavy metals, and organic compounds. Methods used in the measurement of chemical speciation are discussed including physiochemical methods, electrochemical methods, and bioassay. (Baker-IVI)
W85-00600

EFFECT OF PH ON METHYL MERCURY PRODUCTION AND DECOMPOSITION IN LAKE SEDIMENTS,

Manitoba Univ., Winnipeg. Dept. of Microbiology
P. S. Ramlal, J. W. M. Rudd, A. Furutani, and L. Xun.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 685-692, April, 1985. 34 Ref. NRC grant 79-00312.

Descriptors: *Hydrogen ion concentration, *Methyl mercury, *Decomposition, *Lake sediments, Mercury compounds, Ontario, Interstitial water, Methylation, Demethylation, Acidification.

Mercury methylation was measured in surficial sediments taken from unacidified and experimentally acidified lakes in the Experimental Lakes Area, northwestern Ontario. A reduction in the pH of sediments lowered the rate of Hg-203 methylation. Methylation was undetectable at pH < 5.0. This decrease in mercury methylation was probably related to a shortage of available inorganic mercury when the pH of the sediment porewater was reduced. Below pH 6.0, inorganic mercury concentrations in porewater, measured with 203Hg, were reduced to less than 20% of that found at unaltered pH. A comparison of methylation and demethylation rates was made at various pH's. The rate of demethylation decreased to a lesser extent than methylation as the pH was lowered. This research indicates that enhanced mercury methylation in the sediment is not responsible for the observed increase in mercury levels in fish from acidified lakes. (Author's abstract)
W86-00605

NICKEL ACCUMULATION BY SCENEDESMUS AND DAPHNIA: FOOD-CHAIN TRANSPORT AND GEOCHEMICAL IMPLICATIONS,

Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
C. J. Watras, J. MacFarlane, and F. M. M. Morel.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 724-730, April, 1985. 4 Fig, 2 Tab, 42 Ref.

Descriptors: *Nickel, *Bioaccumulation, *Food chains, *Geochemistry, Scenedesmus, Daphnia, Particulate matter, Algal growth, Sediments.

The accumulation of Ni in two levels of a simple aquatic food chain was determined as a function of the concentration of the free metal ion. In NTA-buffered media, Scenedesmus obliquus accumulated Ni to concentrations 30-300 times above ambient. At pNi (= -log Ni(2+) concentration) below 8, algal growth rate declined, cellular Ni quota increased, but no change in the relative size of labile and nonlabile Ni pools was detected. In the same media, Daphnia magna also concentrated Ni but only to levels slightly above ambient. Both short-term (72-h) and long-term (13-d) incubations with D. magna indicated that direct uptake from solution rather than uptake from ingested algae was the primary accumulation vector. There was no biomagnification from the algae to the zooplankton. Ingested particulate Ni was concentrated presumably in fecal matter, which normally sinks to the sediment. (Author's abstract)
W86-00607

5C. Effects Of Pollution

CALCIUM CHLORIDE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.

Environmental Protection Service, Ottawa (Ontario).
May 1984. 76 p, 27 Fig, 6 Tab, 112 Ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Calcium chloride, *Chemical spills, *Spills, *Aquatic life, *Toxicity, *Water pollution prevention, Transportation, Lakes, Fishkill, Environmental effects, Pollutant identification, Chemical properties, Physical properties.

Information useful for designing countermeasures for calcium chloride spills and for assessing their effects on the environment includes a summary of pertinent data, chemical and physical properties, production and transportation, fate in the environment, toxicity to aquatic life and other organisms, suggested countermeasures, and analytical methods. When spilled into water, calcium chloride dissolves rapidly. Mixing in still water is by molecular diffusion; in streams, by turbulence. Nomograms are given for calculating calcium chloride concentrations in nontidal rivers and in lakes. If spilled onto soil, the potential for contamination of groundwater and surface water exists. Nomograms show how calcium chloride travels in coarse sand, silty sand, and clay till. The 4-day median lethal toxicity for aquatic life is $>$ 1000 mg per liter. Fishkills were reported at concentrations of 555 mg per liter (168 hours) to 7752 mg per liter (22 hours). Toxicity studies on fish, frogs, and microorganisms at levels of 84,000 to 22,080 mg per liter are reported. Three methods are suggested for treating water contaminated with calcium chloride: (1) add soda ash and neutralize the clear water with hydrochloric acid, (2) mixed ion exchange, and (3) reverse osmosis.
W86-00309

FERRIC CHLORIDE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.

Environmental Protection Service, Ottawa (Ontario).
August 1984. 88 p, 22 Fig, 6 Tab, 192 Ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Ferric chloride, *Chemical spills, *Spills, *Aquatic life, *Toxicity, *Water pollution prevention, Transportation, Rivers, Lakes, Fishkill, Environmental effects, Pollutant identification, Chemical properties, Physical properties.

Information useful for designing countermeasures for ferric chloride spills and for assessing their effects on the environment includes a summary of pertinent data, chemical and physical properties, production and transportation, fate in the environment, toxicity to aquatic life and other organisms, previous spill experiences, suggested countermeasures, and analytical methods. When spilled into water, ferric chloride dissolves and mixes rapidly. Mixing takes place by molecular diffusion in still water and by turbulence in streams. Ferric chloride hydrolyzes in all but the most acid water to form a hydrous ferrous oxide suspension. Nomograms are given for calculating pollutant concentrations in nontidal rivers and in lakes. If spilled onto soil, the potential for contamination of groundwater and surface water exists. Nomograms show how ferric chloride travels in coarse sand, silty sand, and clay till. The 4-day median lethal toxicity for aquatic life has not been assigned. Fishkill and fish toxicity data are reported. Effects on microorganisms and invertebrates are listed. Ferric chloride does not biodegrade. It contributes to sludge volume accumulation in water treatment plants. It inhibits sludge digestion in wastewater treatment plants at 500-1000 mg per liter. Ferric chloride spills into water reduce the pH, harming aquatic life. A contaminated water body may be neutralized with a base such as sodium bicarbonate and the resulting precipitate removed by sedimentation or filtering.
W86-00310

CHLORINE: ENVIRONMENTAL AND TECHNICAL INFORMATION FOR PROBLEM SPILLS.

Environmental Protection Service, Ottawa (Ontario).
March 1984. 122 p, 31 Fig, 10 Tab, 256 Ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Chlorine, *Chemical spills, *Spills, *Aquatic life, *Toxicity, *Water pollution prevention, Transportation, Rivers, Lakes, Fishkill, Invertebrates, Amphibians, Aquatic animals, Degradation, Environmental effects, Pollutant identification, Chemical properties, Physical properties, Activated carbon.

Information useful for designing countermeasures for chlorine spills and for assessing their effects on the environment includes a summary of pertinent data, chemical and physical properties, production and transportation, fate in the environment, toxicity to aquatic life and other organisms, suggested countermeasures, previous spill experiences, and analytical methods. When spilled into water, liquid chlorine sinks and boils, producing gaseous and dissolved toxic materials, including hypochlorous acid and hydrochloric acid. Nomograms are given for calculating chlorine concentrations in nontidal rivers and in lakes. The 4-day median lethal toxicity rating for aquatic life is less than 1 mg per liter. Fishkills have been reported in fresh water at concentrations of 0.3-2.2 mg per liter and exposures up to 4 hr. Fish toxicity studies are also reported for concentrations of 0.07-3.0 mg per liter. Toxicity to invertebrates, zooplankton, amphibians, and microflora are listed for fresh water and salt water. Fish and other aquatic life have been killed and stressed by releases of chlorinated wastewater effluents and chlorinated powerplant cooling water. Chlorine degrades rapidly in water, forming chloride as the end product. The fate of chlorine in sea water is complex. Chlorine spilled into water may be adsorbed by activated carbon, applied at 10% of the spill amount over the region occupied by 10 mg per liter or greater level, followed by dredging. Chlorine-contaminated water may be treated by acidification with sulfuric acid

(pH 2.0-3.0) followed by reduction with sodium bisulfite.
W86-00319

COASTAL MARINE RESOURCES INVENTORY, 1983: PEMAQUID POINT TO SPRUCE HEAD,

Maine State Dept. of Marine Resources, West Boothbay Harbor. Marine Resources Lab.
D. J. Card, and R. A. Aho.
(1984). 432 p, 8 Tab, 54 Maps, 305 Ref.

Descriptors: *Water pollution effects, *Fate of pollutants, *Water pollution control, *Marine resources, *Oil spills, *Coasts, *Maine, Clams, Invertebrates, Marine animals, Beaches, Shores, Fish, Lobsters, Marinas, Harbors, Aquaculture, Industrial water, Wildlife, Boating, Pemaquid Point, Spruce Head, Maps, Shellfish.

The marine resources of the Main coast were inventoried to develop information for oil spill protection and damage assessment. In the coastal area from Pemaquid Point to Spruce Head 253 resources were identified which are susceptible to oil spill damage. These were classified into priorities. The soft-shell clam flats (1063 acres with a standing crop of over 48,000 bushels worth $3.6 million) are considered first priority. Second priority resources are lobster holding facilities, aquaculture facilities, anadromous fish streams, industrial intakes, and marinas/boat yards. Priority III is sand beaches, parks, wildlife preserves, critical areas, and natural areas. Priority IV is scenic sites, historic sites, and boat ramps. A user's guide gives directions for rapid response to an oil spill on the coast. The fate of oil in the marine environment and the biological effects of oil on various marine organisms (fish and invertebrates) are discussed.
W86-00322

ABATE: EFFECTS OF THE ORGANOPHOSPHATE INSECTICIDE ON BLUEGILLS AND INVERTEBRATES IN PONDS,

Columbia National Fisheries Research Lab., MO.
H. O. Sanders, D. F. Walsh, and R. S. Campbell.
Technical Papers of the U.S. Fish and Wildlife Service, No. 104, 1981. 6 p, 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Abate, *Insecticides, *Water pollution effects, *Bluegills, Fish, *Invertebrates, Ponds, *Organophosphorus pesticides, Ecological effects, Growth, Fish physiology, Pesticides, Larvae, Biomass.

Application of the organophosphate insecticide Abate three times (at about monthly intervals) to duplicate 0.04 ha earthen ponds at 18 g/ha (4 micrograms/L) - the recommended application rate - and 180 g/ha (40 micrograms/L) caused no mortality of bluegills (Lepomis macrochirus). In ponds treated with 18 g/ha fewer bluegill fry were produced than in control ponds, brain acetylcholinesterase (AChE) activity was not affected, and accelerated growth of both fry and adults appeared to result from heavy feeding on dead or moribund Diptera larvae that resulted from each of the first two applications of Abate. In ponds treated with 180 g/ha ovary development in bluegills was initially faster than in bluegills from control ponds, the number of fry produced per female was lower than in control ponds (but growth of fry was unaffected), brain AChE activity in bluegills was strongly inhibited after the second and third treatments, and biomass of Diptera in the ponds was reduced about 40% but other invertebrates were unaffected. The routine use of Abate at the recommended rate should have little adverse effect on fishery resources. (Author's abstract)
W86-00341

SOURCES, CHEMISTRY, FATE, AND EFFECTS OF CHROMIUM IN AQUATIC ENVIRONMENTS.

Ecological Analysts, Inc., Sparks, MD.
For primary bibliographic entry see Field 5B.
W86-00344

EFFECTS OF OIL ON AQUATIC ORGANISMS: A REVIEW OF SELECTED LITERATURE,

Oklahoma State Univ., Stillwater. Water Quality Research Lab.
S. L. Burks.
American Petroleum Inst., Washington, DC. 69 p, 6 Tab, 195 Ref.

Descriptors: *Oil spills, *Reviews, *Water pollution effects, *Oil pollution, *Ecosystems, *Hydrocarbons, *Aquatic animals, *Aquatic plants, Aquatic environment, Oil, Oily water, Algae, Diatoms, Petroleum products.

Spills of light refined oil on aquatic ecosystems will probably cause extensive mortality of sessile species, but mobile species may not be affected unless confined by physical barriers. Most investigations indicate that both freshwater and marine communities are capable of recovering from an oil spill incident within a year. Measured concentrations of petrogenic hydrocarbons in the water column have been reported to range from nondetectable to 60 micrograms/liter. Chemical dispersants may temporarily increase levels of hydrocarbons in the water column, up to 200 micrograms/liter. Low molecular weight aromatic hydrocarbons dissipate rapidly while compounds with low aqueous solubility persist longer after an oil spill. The toxic properties of crude oils appear to be related to the percentage concentration of aromatic hydrocarbons, molecular weight, and aqueous solubility. Except for the 4- and 5-ring polynuclear aromatic hydrocarbons, the relatively lethal effects to marine fish and invertebrates appear to increase from mono-aromatics to alkylated aromatics to dinuclear aromatics. Larvae of fish and most crustaceans appear to be very susceptible to the water soluble fraction of crude oils. Growth of some species of polychaete worms appears to be tolerant. The greatest potential threat to aquatic ecosystems may be the continuous long-term contamination with petroleum hydrocarbons in surface water runoff from urban areas and in wastewater from municipalities in industrial areas.
W86-00349

HAZARDOUS MATERIALS SPILLS-MANAGEMENT REVIEW,

Texas Transportation Inst., College Station.
For primary bibliographic entry see Field 10D.
W86-00350

IMPACT OF XENOBIOTIC CHEMICALS ON MICROBIAL ECOSYSTEMS.

Fish and Wildlife Service, Washington, DC.
Technical Papers, No. 107, 1982. 36 p. Edited by B. Thomas Johnson.

Descriptors: *Water pollution effects, *Ecosystems, *Microorganisms, *Paraquat, *Aquatic populations, *Xenobiotics, *Detritus, *Organic compounds, Ecological effects, Aquatic environment, Environmental impact statement, Pesticides, Herbicides, Microenvironment, Microbiological studies, Industrial wastes, Environmental effects.

These technical papers were presented at the Annual Meeting of the American Society for Microbiology held in Miami Beach Florida in May of 1980. The estimated 70,000 chemical compounds synthesized annually in the United States include such diverse xenobiotics as cyclic intermediates, dyes, organic pigments, medicinal chemicals, flavor and perfume materials, plastic and resin materials, rubber processing chemicals, elastomers, plasticizers, surface-active agents, and pesticides and related products. The question of the hazards of xenobiotics to microbial ecosystems was raised to meeting participants. In response, reports were presented on the potential role of microbial effects testing (environmental risk assessment), the effects of pesticides on non-target microorganisms in agricultural soil, a scheme for microbial toxicity testing of synthetic organic chemicals, and examples of xenobiotic poisoning of specific and non-specific microbial pathways. A method for biochemical determination of biomass and community structure of estuarine detrital and sedimentary microbiota was outlined for use in assessing the effects of xenobiotics. A paper dealing with the cellular mechanisms of paraquat toxicity was also presented.
W86-00352

ENVIRONMENTAL RISK ASSESSMENT: THE POTENTIAL ROLE OF MICROBIAL EFFECTS TESTING,

Environmental Protection Agency, Washington, DC. Office of Pesticides and Toxic Substances.
J. D. Walker.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 107, 1982, p 3-5. 1 Tab, 20 Ref.

Descriptors: *Microorganisms, *Microbiological studies, *Aquatic environments, *Growth, *Metabolism, *Water pollution effects, *Bioindicators, *Microbial degradation, Ecological effects, Bacteria, Laboratory tests, Testing procedures, Oxidation-reduction potential, Ecosystems.

Environmental microbiology testing involves assessing the effect of microorganisms and microbial processes on chemical substances and determining the effect of chemical substances on microorganisms and microbial processes. Microbial effects testing may provide a sensitive method for detecting potential environmental perturbations. The use of microbial effects tests might have alerted the Life Sciences Corporation to the problems that resulted from releasing what was probably Kepone, into the Hopewell, Virginia biological treatment plant. Microbial effects tests for measuring decomposition of organic substances have provided sensitive and rapid methods for detecting the effects of smelter emissions on microbial processes in soils. Some representative microbial effects tests provide measurements of growth, product formation, and substrate oxidation, reduction or disappearance. Microbial effects tests may provide sensitive, reproducible, and cost-effective methods for detecting the effects of toxic substances on microorganisms and their activities.
W86-00353

MICROBIAL TOXICITY TESTING OF SYNTHETIC ORGANIC CHEMICALS,

Monsanto Co., St. Louis, MO.
W. E. Gledhill.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 107, 1982, p 11-14. 2 Tab, 9 Ref.

Descriptors: *Testing procedures, *Water pollution effects, *Microorganisms, *Ecosystems, *Environmental effects, *Ecological effects, *Microbiological studies, Toxins, Water quality standards, Regulations, Environmental protection, Fate of pollutants, Organic compounds.

Federal regulations such as the Toxic Substances Control Act (TSCA) and the Federal Insecticide, Fungicide, and Rodenticide Act mandate the testing of new chemicals for their toxicity to numerous biological species, including microorganisms. In general microorganisms are less sensitive to xenobiotics than are higher species due to their greater adaptive capabilities, cell wall structure, enzymes and protection afforded by the environment. It was suggested, therefore, that higher organisms be used in initial environmental effects testing and the testing of toxicity to microorganisms be conducted based on initial screening results. A modified TSCA environmental screening program should examine the fate of xenobiotics (mobility and persistence) and the aquatic toxicity to algae, invertebrates and fish. Water quality regulations arising from tests on higher organisms should be sufficiently restrictive to protect microbial populations. At present, there is no consensus as to the best methodology for determination of apppropriate microbial toxicological information. More research is needed in establishing laboratory microcosms to simulate more closely the microbiological processes in the natural environment.
W86-00354

BIOCHEMICAL DETERMINATION OF BIOMASS AND COMMUNITY STRUCTURE OF ESTUARINE DETRITAL AND SEDIMENTARY MICROBIOTA,

Florida State Univ., Tallahassee. Dept. of Biological Science.

D. C. White.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 107, 1982, p 22-28. 2 Fig, 4 Tab, 34 Ref.

Descriptors: *Biomass, *Marine sediments, *Microorganisms, *Ecosystems, *Testing procedures, *Lipids, *Water pollution effects, *Biochemistry, Ecological effects, Oil pollution, Environmental protection, Metabolism, Estuarine environment, Bioindicators.

Sedimentary microbial biomass, metabolic activity, nutritional status, and community structure were determined by the analysis of extractable lipids and hydrolysis products of the lipid extracted residue in microbial communities in the laboratory or in the field. These methods have been validated by analysis of mixtures of microbial monocultures isolated from microbial assemblies, by measurements of the effects of grazing by selective deposit feeding invertebrates, and by scanning electron microscopic analysis of detrital microbial assemblies manipulated with antibiotics, nutrients, and light. Such methods have shown that milligrams/liter concentrations of xenobiotics in fluids used in oil and gas well drilling can significantly modify the biomass and community structure of microbial assemblies colonizing marine sand. These techniques can also allow estimation of the validity of using microcosm test systems to determine the impacts of xenobiotics in the field. These methods could greatly strengthen the legal applicability of data used by regulatory agencies in protecting estuarine environments.
W86-00355

CELLULAR MECHANISMS OF PARAQUAT TOXICITY,

Columbia National Fisheries Research Lab., MO.
M. Heitkamp, and O. R. Brown.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 107, 1982, p 29-36. 4 Fig, 5 Tab, 40 Ref.

Descriptors: *Paraquat, *Escherichia coli, *Growth, *Rodents, *Defoliants, *Water pollution effects, *Lethal limit, *Pesticide toxicity, Herbicides, Bacteria, Microorganisms, Pesticides, Toxins, Amino acids, Agricultural chemicals, Fish, Mammals, Mortality, Toxicity.

Paraquat (1,1'-dimethyl-4,4'-bipyridylium ion), a non-selective contact defoliant and herbicide is toxic to various organisms, including man. Oxygen radicals are reportedly generated in tissues by paraquat; thus there is a potential link between the mechanisms of poisoning by paraquat and hyperbaric oxygen. A study was undertaken of specific sites of paraquat toxicity, using bacteria and rats. Specific amino acids and niacin partly protected Escherichia coli from the bacteriostatic effects of 1mM paraquat. The amino acids appeared to protect the bacteria because aerobic paraquat poisons the same pathways of amino acid biosynthese previously found to be sensitive to hyperbaric oxygen. Specifically, dihydroxyacid dehydratase, which is required for branch-chain amino acid biosynthesis, was poisoned in cells exposed to paraquat. Niacin further protected E. coli against growth inhibition and specifically against the decrease in nicotinic acid adenine dinucleotide (NAD) that otherwise occurred. NAD was decreased because paraquat apparently poisoned the same enzyme (quinolinate phosphoribosyl transferase) that was previously reported to be poisoned by hyperbaric oxygen. Niacin gave significant protection to rats injected with lethal amounts of paraquat; the time to LT50 was increased from 60 to 115 h, and the percentage of animals surviving for 1 week was increased from 20 to 45 in a study with four groups of 25 animals each. (Author's abstract)
W86-00356

CHEMICAL CONTAMINANTS AND ABNORMALITIES IN FISH AND INVERTEBRATES FROM PUGET SOUND,

National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
D. C. Malins, B. B. McCain, D. W. Brown, A. K. Sparks, and H. O. Hodgins.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-11518 8. NOAA Technical Memorandum OMPA-19, June 1982. 168 p. 44 Fig, 42 Tab, 108 Ref, Append.

Descriptors: *Invertebrates, *Water pollution effects, *Fish, *Hydrocarbons, Polychlorinated biphenyls, Water pollution effects, Pollutants, *Puget Sound, Liver, Metals, Lead, Arsenic, Mercury, Sediments, Urban areas, Rural areas, Washington.

Samples of sediment and selected bottom-dwelling fish and invertebrates were collected at regular intervals from 1978 to the spring of 1981 from urban and rural areas of Puget Sound. The concentrations of aromatic hydrocarbons (AH), polychlorinated biphenyls (PCB) and chlorinated butadienes were widely distributed in sediment from Puget Sound with the highest concentrations in Commencement Bay and Elliott Bay. Arsenic and mercury were only detected in sediment from urban areas, whereas lead was high in both urban (130,000 ppb, dry weight) and rural (15,000 ppb, dry weight) sediments. All of the above chemicals were detected in higher concentrations in biota from urban areas. Bottom fish, crabs, and shrimp had a variety of pathological conditions. In English sole, the fish species most widely distributed throughout Puget Sound, liver neoplasms, preneoplastic and necrotic liver lesions were correlated with sediments having high concentrations of metals and AH.
W86-00358

EFFECTS OF TOXICANTS ON PLANKTON,

Environmental Research Lab., Gulf Breeze, FL.
G. E. Walsh.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-117044. Report EPA-600/D-82-338, 1982. 67 p. 216 Ref.

Descriptors: *Industrial wastes, *Toxic wastes, *Municipal wastes, *Plankton, Algae, Heavy metals, Pesticides, Toxicity, Pollutants, Pollution effects, Growth inhibition, Oil pollution, Zooplankton, Larvae, Eggs, Crustaceans, Sediments, Dredging.

The effects of heavy metals, pesticides, and industrial and municipal wastes on holo- and meroplankton in the field and laboratory are reviewed. The most commonly measured response of unialgal cultures to pollutants is growth inhibition. Reports in recent years have included descriptions of the effects of pollutants on morphology, physiology and population interactions. Algae are more sensitive to industrial and municipal wastes, but more resistant to single pollutants, than animals.
W86-00360

CHLORINATED HYDROCARBONS AS A FACTOR IN THE REPRODUCTION AND SURVIVAL OF LAKE TROUT (SALVELINUS NAMAYCUSH) IN LAKE MICHIGAN.

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
Technical Papers of the U.S. Fish and Wildlife Service, No. 105, 1981. 6 p, 3 Fig, 3 Tab, 11 Ref.

Descriptors: *Lake Michigan, *Water pollution effects, *Trout, Lakes, *DDE, *Halogenated pesticides, *Pesticide toxicity, *Polychlorinated biphenyls, *Aroclors, Pesticides, Fish eggs, Hatching, Incubation, Growth, Metabolism, Fish populations, DDT, Ecological effects, Fish behavior, Hydrocarbons, Larvae, Michigan.

Although lake trout (Salvelinus namaycush) were considered extinct in Lake Michigan by the mid 1950's, control of the parasitic sea lamprey (Petromyzon marinus) and extensive restocking resulted in an abundance of hatchery-produced lake trout by the early 1970's. However, no naturally produced yearling or older lake trout have been found in the lake in nearly a decade of sampling. It was hypothesized that DDT and its metabolites and polychlorinated biphenyls (PCB's) in lake waters may adversely affect the hatchability and survival of larval fish. However, manually stripped and fertilized trout eggs have hatched successfully and the fry have survived normally under a variety of hatchery conditions. A series of studies were conducted at the Great Lakes Fishery Laboratory on the effects of chlorinated hydrocarbons on the reproduction and survival of Lake Trout in Lake Michigan. Specific investigations examined the comparative hatchability of lake trout eggs under different conditions of contaminant burden and incubation, and the effects of chronic exposure to PCB's and DDE on growth and mortality of fry, swimming performance of young lake trout, vulnerability of young lake trout to predation, and temperature selection by young lake trout. Laboratory and field studies on the effects of contaminants on the biochemistry and metabolism of lake trout were also conducted.
W86-00363

INTRODUCTION AND SUMMARY,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
W. A. Wilford, R. A. Bergstedt, W. H. Berlin, N. R. Foster, and R. J. Hesselberg.
In: Technical paper of the U.S. Fish and Wildlife Service, No. 104, 1981, p 1-7. 24 Ref.

Descriptors: *Lake Michigan, *Water pollution effects, *Trout, *Pesticides, *DDE, *Pesticide toxicity, *Polychlorinated biphenyls, *Aroclors, Growth, Metabolism, Fish eggs, Fish populations, Hydrocarbons, Halogenated pesticides, Ecological effects, Fish behavior, Michigan.

Studies were performed at the Great Lakes Fishery Laboratory on the performance and survival of fry hatched from eggs of Lake Michigan lake trout and exposed for 6 months to PCB's (Aroclor 1254) and DDE at concentrations similar to those present in offshore waters and zooplankton of Lake Michigan (10.0 nanograms/liter PCB's and 1.0 nanograms/liter DDE in water; 1.0 micrograms/g PCB's and 0.1 micrograms/g DDE in food), and at concentrations 5 and 25 times higher. Cumulated mortality of the exposed fry was nearly twice that of unexposed controls. Evaluations of the growth, swimming performance, predator avoidance behavior, temperature preference, and metabolism of the fry showed no significant effects attributable to exposure to PCB's and DDE, except for a lowering of preferred temperature at the highest exposure level for each contaminant and additively when both contaminants were combined. Although several factors undoubtedly contributed to the lack of recruitment of naturally produced lake trout in Lake Michigan, the levels of PCB's and DDE present during the early to mid 1970's were sufficient to significantly reduce survival of any fry produced in the lake and thereby impede restoration of the lake trout population to self-sustainability.
W86-00364

COMPARATIVE HATCHABILITY OF LAKE TROUT EGGS DIFFERING IN CONTAMINANT BURDEN AND INCUBATION CONDITIONS,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
M. J. Mac, W. H. Berlin, and D. V. Rottiers.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 104, 1981, p 8-10. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Lake Michigan, *Water pollution effects, *Hatching, *Trout, *Fish eggs, *Polychlorinated biphenyls, *DDE, *Pesticides, *Aroclors, Larvae, Hydrocarbons, Chlorinated hydrocarbons, Halogenated pesticides, Ecological effects, Mortality, Lakes, Michigan.

In 1972, fertilized eggs of lake trout (Salvelinus namaycush) from the Marquette (Michigan) State Fish Hatchery (where levels of contaminants are relatively low) and eggs from lake trout collected in Michigan waters of Lake Michigan near Saugatuck and Charlevoix (where levels of PCB's and DDE are elevated) were incubated at hatchery temperatures (6 degrees) and at temperatures simulating the natural temperature cycle of Lake Michigan (1-8 degrees). Survival to yolk absorption of larvae from these three sources ranged from

40.3 to 65.5%, and no correlation was observed between survival and the level of PCB's and DDE in the eggs. Additional studies in 1975 with lake trout eggs from the same three sources confirmed previous observations that the elevated levels of PCB's and DDE in eggs from Lake Michigan did not appear to affect the percent hatch of lake trout eggs or survival of the fry to the swim-up stage. When fry hatched from eggs with an elevated contaminant burden were starved for several weeks, no abnormal increase in posthatching mortality during the period when the yolk stores were being consumed was observed. (Author's abstract)
W86-00365

GROWTH AND MORTALITY OF FRY OF LAKE MICHIGAN LAKE TROUT DURING CHRONIC EXPOSURE TO PCB'S AND DDE,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
W. H. Berlin, R. J. Hesselberg, and M. J. Mac.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 104, 1981, p 11-22. 2 Fig, 8 Tab, 37 Ref.

Descriptors: *Water pollution effects, *Polychlorinated biphenyls, *DDE, *Pesticides, *Growth, *Trout, *Mortality, *Bioaccumulation, Aroclors, Hydrocarbons, Halogenated pesticides, Lakes, *Lake Michigan, Fish, Michigan.

Fry hatched from eggs of Lake Michigan lake trout were chronically exposed to concentrations of PCB's and DDE similar to those found in water and plankton in southeastern Lake Michigan (LX) and to concentrations 5 (5X) and 25 (25X) times greater. Body levels of contaminants in fry decreased at 1X level of PCB's and at 1X and 5X levels of DDE, but generally increased at all other contaminant exposure levels. PCB and DDE uptake was evident from increased body burdens of the contaminants at all exposure levels and in the controls. Growth was not significantly affected by any of the contaminant exposure levels. Mortalities of fry exposed to the 1X and 5X contaminant levels were significantly less than those of control fry before day 56. Between days 57 and 136, mortality rates increased rapidly and were significantly higher in all exposed groups than in the control group. Although mortality was lower in the last 40 days of exposure, it continued to be significantly higher in all exposed fry than in controls, except those in the 1X and 5X PCB groups. By the end of the 176-day study, the total cumulative mortality ranged from 30.5 to 46.5% in the exposed groups and was 21.7% in the control group.
W86-00366

SWIMMING PERFORMANCE OF YOUNG LAKE TROUT AFTER CHRONIC EXPOSURE TO PCB'S AND DDE,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
D. V. Rottiers, and R. A. Bergstedt.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 104, 1981, p 23-28. 2 Fig, 3 Tab, 9 Ref.

Descriptors: *Fish behavior, *Water pollution effects, *Polychlorinated biphenyls, *Pesticides, *DDE, *Aroclors, *Trout, *Halogenated pesticides, *Ecological effects, Lakes, *Lake Michigan, Hydrocarbons, Fish populations, Michigan.

Swimming performance was measured in fry of lake trout hatched from Lake Michigan fish. The fry were exposed for 50, 110, and 165 days to PCB's, DDE, and a combination of these two contaminants in both food and water at concentrations equal to, and 5 and 25 times higher than levels found in Lake Michigan water and plankton. Swimming performance was assessed by forcing the fry to swim through a continuous series of incrementally increased velocities until the fish were exhausted. Although significant differences in swimming performance were observed between a few test groups, no relation between swimming performance of the fry and exposure to PCB's or DDE, or both was noted at the concentrations tested. Inasmuch as swimming performance apparently was not affected by the levels of contamination by PCB's and DDE in Lake Michigan, impairment of swimming by these contaminants cannot account for the failure of lake trout reproduction in Lake Michigan.
W86-00367

VULNERABILITY OF YOUNG LAKE TROUT TO PREDATION AFTER CHRONIC EXPOSURE TO PCB'S AND DDE,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
M. J. Mac.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 104, 1981, p 29-32. 3 Tab, 10 Ref.

Descriptors: *Fish populations, *Trout, *Lake Michigan, *DDE, Polychlorinated biphenyls, *Predation, *Fish behavior, *Water pollution effects, Lakes, Pesticides, Aroclors, Ecological effects.

The vulnerability of fry of Lake Michigan lake trout (Salvelinus namaycush) to predation by rainbow trout (Salmo gairdneri) was tested after the fry had been exposed to PCB's, DDE, and a combination of these contaminants in both water and food at concentrations corresponding to ambient levels (1X) in water and plankton in Lake Michigan and at levels 5 and 25 times higher. Vulnerability of the fry, measured as the ratio of escapes to predator attacks, was not significantly increased by either 90 or 165 days of exposure to the contaminants at any of the concentrations tested, and no behavioral differences were observed between control and exposed fry in their reaction to predators. Exposure to PCB's and DDE at environmental and higher concentrations thus did not affect the vulnerability of lake trout fry to predation. This observation suggests that the failure of lake trout reproduction in Lake Michigan was not caused by contaminant-induced reductions in the ability of the fry to escape predators. (Author's abstract)
W86-00368

TEMPERATURE SELECTION BY YOUNG LAKE TROUT AFTER CHRONIC EXPOSURE TO PCB'S AND DDE,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
M. J. Mac, and R. A. Bergstedt.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 104, 1981, p 33-35, 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Polychlorinated biphenyls, *DDE, *Water temperature, *Pesticides, *Fish behavior, *Trout, *Ecological effects, *Lake Michigan, Survival, Lakes, Fish populations, Halogenated pesticides, Aroclors, Michigan.

Temperature selection tests were conducted with fry of Lake Michigan lake trout (Salvelinus namaycush) exposed to PCB's, DDE and a combination of these contaminants in food and water at levels 25 times the ambient levels in plankton and water in Lake Michigan. Fry were placed in a vertical temperature gradient tank which was checked for dissolved oxygen concentration along the gradient to exclude the possibility of gas bubble disease. The tank was also checked for the possibility of N2 supersaturation by confining yearling yellow perch in the warmest surface layers for 1 wk, but no signs of gas bubble disease were detected. Results showed that exposure of fry to PCB's and DDE lowered their preferred temperature. After 98 days of exposure, mean preferred temperatures were 10.3 degrees for fry exposed to PCB's 9.8 degrees for fry exposed to DDE, and 8.7 degrees for those exposed to PCB's plus DDE, as compared with 11.2 degrees for control fry. Frequency distributions of residence temperatures were significantly different among all treatments. Such a change in the preferred temperature caused by a contaminant could reduce the energetic efficiency of a fish and thereby reduce growth and survival.
W86-00369

BIOCHEMISTRY AND METABOLISM OF LAKE TROUT: LABORATORY AND FIELD STUDIES ON THE EFFECTS OF CONTAMINANTS,

National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
D. R. M. Passino.
In: Technical Papers of the U.S. Fish and Wildlife Service, No. 104, 1981, p 36-42. 4 Tab, 39 Ref.

Descriptors: *Lake Michigan, *Trout, *Water pollution effects, *Enzymes, *Pesticides, *DDE, *DDT, *Polychlorinated biphenyls, *Metabolism, Ecological effects, Fish, Fish behavior, Aroclors, Halogenated pesticides, Michigan.

Several biochemical indicators of stress were measured in fry of Lake Michigan lake trout exposed to PCB's (Aroclor 1254) and DDE in food and water and in unexposed fry. No difference in treatments were observed in oxygen consumption rates of lactate concentrations of unexercised fry, but apparent differences in specific swimming speed and lactate response in fry that swam to exhaustion suggested that exposed fry had lower stamina. Observed differences between biochemical profiles of 1-day-old sac fry reared from eggs of lake trout collected off Saugatuck and those originating from eggs of brood stock at the Marquette (Michigan) hatchery may have been caused by organochlorine contamination or by genetic and dietary differences between parental stocks. Activity of allantoinase was measured in juvenile and adult trout as an indicator of sublethal effects of Great Lakes contaminants. The 50% inhibition of allantoinase in vitro occurred at 6.0 mg/liter Cu(++), 6.7 mg/liter Cd(++), 34 mg/liter Hg(++), and 52 mg/liter Pb(++). In vivo exposure to PCB which cause accumulations of 2.6 micrograms/g (whole fish) activated allantoinase slightly to the 10% significance level. Allantoinase activity was negatively correlated with total length for fish from Lake Michigan but not for fish from Lake Superior or from laboratory stocks. Hg, PCB's and DDT, acting in combination or with other contaminants may be the cause of the negative correlation of allantoinase activity with size in Lake Michigan lake trout.
W86-00370

EFFECT OF CADMIUM AND ZINC ON INTESTINAL ABSORPTION OF XYLOSE AND TRYPTOPHAN IN THE FRESH WATER TELEOST FISH, HETEROPNEUSTES FOSSILIS,

D.A.V. Coll., Muzaffarnager (India). Dept. of Zoology.
K. V. Sastry, and S. Subhadra.
Chemosphere, Vol. 13, No. 8, p 889-898, 1984. 4 Tab, 24 Ref.

Descriptors: *Fish, *Xylose, *Tryptophan, *Cadmium, *Zinc, Toxicity, Heavy metals, Nutrients, Water pollution effects.

Two experimental conditions were used to study the effect of cadmium and of zinc on the rate of uptake of a pentose sugar xylose and an aminoacid tryptophan by the intestine of a teleost fish, Heteropneustes fossilis. In the first experimental condition four concentrations of cadmium or zinc (1.0, 0.1, 0.01 or 0.001 mM) mixed with the nutrient solution were placed in the intestinal sacs and the rate of absorption was recorded after 1 hr at 23 C. In the second experiment the fish were exposed by bath to a sublethal concentration of cadmium (0.26 mg/l) or zinc (4 mg/l) for 15 min and 30 days and the rate of absorption of the two nutrients measured. The presence of cadmium or zinc in the intestine or in the ambient water can decrease the rate of transport of xylose and tryptophan and the activity of intestinal brush border Na(+), K(+) ATPase. The rate of absorption of each of the two nutrients is inversely related to the concentration of each of the two heavy metals in the instilled solution and to the period of exposure of test fish to the heavy metals. Higher concentrations of both the heavy metals decreased nutrient absorption rates to a greater extent than do lower concentrations in vitro. The decreases were most marked between 0.01 and 0.001 mM of cadmium or zinc. Thirty days exposure to each heavy metal in vivo

produced a greater decrease in the rate of absorption of the two nutrients than did exposure for 15 days. Heavy metals may also bind to the proteins of the brush border membrane of the mucosal cell and thus alter their permeability. (Baker-IVI)
W86-00390

OCCURRENCE OF R-PLASMIDS IN ESCHERICHIA COLI AND COLIFORM GERMS FROM WATER AND WASTEWATER; PART 2: METHODS OF ISOLATION OF R+ -BACTERIA FROM SURFACE AND WASTEWATER, THE TRANSFER OF THEIR R-PLASMIDS AS WELL AS THE DETERMINATION OF THE RESISTANCE IMAGES (UBER DAS VORKOMMEN VON R-PLASMIDEN IN ESCHERICHIA COLI UND KOLIFORMEN KEIMEN AUS WASSER UND ABWASSER; TEIL 2: METHODEN DER ISOLIERUNG VON R+ - BACTERIEN AUS OBERFLACHEN - UND ABWASSER, DES TRANSFERS IHRER R-PLASMIDE SOWIE DIE BESTIMMUNG DER RESISTENZBILDER),

Institut fur Experimentelle Epidemiologie, Wernigerode.
For primary bibliographic entry see Field 5D.
W86-00398

'MAN AND BIOSPHERE' - STUDIES ON SIKKIM HIMALAYAS. PART 2: ACUTE TOXICITY OF MIXED COPPER-ZINC SOLUTIONS ON COMMON CARP, CYPRINUS CARPIO (LINN.),

Delhi Univ. (India). Dept. of Anthropology.
B. S. Khangarot, A. Sehgal, and M. K. Bhasin.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 2, p 131-145, 1984. 3 Tab, 17 Ref.

Descriptors: *Copper, *Zinc, *Toxicity, *Carp, Fish, Water pollution effects, Heavy metals, Synergism.

A study was made of the effects of Cu-Zn mixtures to determine whether the acute toxicities of Cu and Zn are synergistic or antagonistic in the common carp, Cyprinus carpio. In batch experiments for 6 to 48 hr, individuals of C. carpio were exposed to mixed solutions of copper and zinc sulfate: pH = 6.3, temperature 15 C, 6.8 mg/l oxygen, 7.1 mg/l Ca(2+), 0.7 mg/l Mg(2+). The LC50 for the individual substances on exposures of 24 and 48 hr amounted to 9.04 and 7.28 mg/l for zinc and 0.11 and 0.095 mg/l for copper. The sum of the biological activity of the two kinds of metal ions is assessed according to Marking's index: at low concentrations of the mixed solutions the two metals show an additive effect, at higher concentrations a synergistic effect occurs. (Baker-IVI)
W86-00404

TOXICITY OF THE HERBICIDE 2,4-D-NA TO TWO SPECIES OF FRESHWATER PRAWN OF THE GENUS MACROBRACHIUM,

Gorakhpur Univ. (India). Dept. of Zoology.
Omkar, and G. S. Shukla.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 3, p 285-289, 1984. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Toxicity, *Herbicides, *Prawn, *Dichlorophenoxy acetic acid, Organic compounds, Pesticide toxicity, Water pollution effects.

The herbicide 2,4-D-Na (the sodium salt of 2,4-dichlorophenoxy acetic acid) is commonly used in eastern Uttar Pradesh (India); as a consequence of its use, the herbicide ultimately finds its way to the aquatic environment through runoff water and affects aquatic life. In batch experiments with exposure for 24 to 96 hr Macrobrachium naso and M. dayanum were exposed to solutions of 2,4-D-Na. The LC50,96 hr are 2.397 g/l for M. naso and 2.275 g/l for M. dayanum. No mortality was observed in solutions of 2.1 and 1.85 g/l. The differences in toxicity are not dependent on the size of the organisms, but they are species-specific. The toxicity reactiions to 2,4-D-Na were seen earlier in M. dayanum than M. naso even at the same concentrations. The specimens became excited, showed erratic swimming and attempted to jump out of the test container. Violence was seen next, followed by paralysis and death. (Baker-IVI)
W86-00413

EFFECT OF ALDRIN ON THE CARBOHYDRATE METABOLISM OF A FRESHWATER PRAWN MACROBRACHIUM LAMARREI (H.-M. EDWARDS) CRUSTACEA, DECAPODA,

Gorakhpur Univ. (India). Dept. of Zoology.
Omkar, R. Murti, and G. S. Shukla.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 5, p 549-552, 1984. 1 Tab, 19 Ref.

Descriptors: *Pesticides, *Toxicity, *Prawn, *Aldrin, Water pollution effects, Organic compounds, Aldrin, Metabolism, Pesticide toxicity.

The acute toxicity of aldrin to freshwater prawn was studied with particular attention to biochemical and physiological changes induced by aldrin. Aldrin had a marked effect on hepatic glycogen of Macrobrachium lamarrei. The decrease in the glycogen content was observed in all the three concentrations after each exposure which showed a time- and dose-dependent relation. The decrease in hepatic glycogen was more significant in the lowest concentration after 48 and 72 hr and highly significant in two higher concentrations up to 72 hr and in all the three concentrations after 96 hr of exposure. The blood glucose level was decreased significantly in 0.017 and 0.021 mg/l aldrin after 24 hr. The decrease in blood glucose increased with an increase in the concentration of aldrin. A rise in the glucose level was observed after 48 and 72 hr of exposure, which was more significant in two higher concentrations after 48 hr and in the lowest concentration after 72 hr exposure. The decrease in the blood glucose level after 96 hr exposure was significant at $P<0.05$, $P<0.01$, and $P<0.001$ in solutions of 0.008, 0.017, and 0.021 mg/l, respectively. The depletion in blood glucose within 24 hr of aldrin exposure indicates that the blood glucose has been used to meet the energy requirement due to the stress. (Baker-IVI)
W86-00421

'MAN AND BIOSPHERE' - STUDIES ON THE SIKKIM HIMALAYAS. PART 3: ACUTE TOXICITY OF MIXTURES OF ENDRIN AND CALAXIN ON THE TADPOLE LARVAE OF THE FROG RANA HEXADACTYLA,

Delhi Univ. (India). Dept. of Anthropology.
B. S. Khangarot, A. Sehgal, and M. K. Bhasin.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 5, p 563-565, 1984. 2 Tab, 12 Ref.

Descriptors: *Water pollution effects, *Toxicity, *Frogs, Endrin, Calaxin, Pesticides, Organic compounds, Tadpoles, Immature growth stages, Synergism.

The knowledge of the toxicity of mixtures is important, because interactions may increase or decrease the toxicity depending upon the properties of the pollutants. Further, a toxicant never occurs singly in polluted waters but is always found in mixtures. The acute toxicities of mixtures of endrin and calaxin on tadpoles of the frog Rana hexadactyla for 48 hr exposures were investigated. The LC50s and 95% confidence limits of individual insecticides at 48 hr exposures indicate that calaxin was more toxic than endrin. The sum of the biological activity of the two toxicants is 1.235, the toxicity is less than additive. A combination of endrin and calaxin (1:1) produced an additive index of -0.235, which suggests a less than additive toxicity. The 2:1 and 1:2 ratios (endrin:calaxin) were synergistic. (Baker-IVI)
W86-00422

SENSITIVITY OF SOUTHERN QUEBEC LAKES TO ACIDIC PRECIPITATION,

Quebec Univ., Sainte-Foy.
M. Lachance, B. Bobee, and Y. Grimard.
Water, Air, and Soil Pollution, Vol. 25, No. 2, p 115-132, June, 1985. 4 Fig, 4 Tab, 40 Ref.

Descriptors: *Acid rain, *Quebec, *Lakes, Water pollution effects, Physicochemical properties, Acidity, Sulfates, Lithology, Seasonal variation, Spatial distribution, Mineralization, Canadian Shield.

Physico-chemical data from 258 Quebec lakes collected during spring and summer 1980 are examined in order to obtain a first general diagnosis of lake acidification in Quebec. The spatial variation of the mineralization of lakes is interpreted in relation to lithology and glacial deposits, allowing the identification of Canadian Shield areas particularly threatened by acid precipitation. Quebec lakes may be classified into two groups with high or low sensitivity to acidification, according to their location on either the Canadian Shield or in the Appalachian area. The study of the spatial distributions of conductivity and alkalinity values has allowed the identification of Shield areas particularly sensitive to acid precipitation. The southwest to north-east gradient in the concentration of sulfate indicates the importance of long range atmospheric transport of S and suggests that sulfate levels have substantially increased in southern Quebec lakes. The frequency distribution of pH values and the existence of a relation between pH and sulfate concentrations suggest that many lakes on the southern part of the Shield are probably affected by acid precipitation. Data obtained in the spring from some Shield lakes show a substantial decrease in pH and alkalinity during this period, compared to summer values, and demonstrate the importance of these atmospheric episodic inputs to sensitive lakes. (Baker-IVI)
W86-00427

RESPONSE OF CLIMBING PERCH, ANABAS TESTUDINEUS TO INDUSTRIAL POLLUTANTS: HEAD KIDNEY PEROXIDASE, IODIDE PEROXIDASE, AND BLOOD THYROXINE PROFILES,

Visva-Bharati Univ., Santiniketan (India). Environmental Toxicology Lab.
S. Chatterjee, and S. Bhattacharya.
Water, Air, and Soil Pollution, Vol.25, No.2, p 161-174, June, 1985. 7 Fig, 5 Tab, 29 Ref.

Descriptors: *Water pollution effects, *Fish, *Peroxidase, Phenols, Industrial wastes, Mercuric chloride, Cadmium chloride, Ammonia, Climbing perch, Perch.

Climbing perch, Anabas testudineus, were exposed under static conditions to nonlethal concentrations of HgCl2 (0.166 ppm as HgCl2), CdCl2 (166.66 ppm as CdCl2), phenol (21.11 ppm as phenol) and NH3 (54 ppm as NH3) for 2 days and then transferred to toxicant free water for 30 days. Fish were also treated chronically for 30 days with a mixture of these toxicants containing 0.083 ppm HgCl2, 66.66 ppm CdCl2, 6.66 ppm phenol and 27 ppm NH3. A chronic test for 30 days was also conducted with a factory effluent collected from the Durgapur Industrial Complex. A distinct inhibitory role of phenol, NH3, Cd, and Hg mixture of the toxicants and factory effluent was established. Not only is the enzyme inhibited during the 48 hr exposure tests but also the decrement continues long after transfer of fish to toxicant free water. Inhibition of peroxidases may result in the dysfunction of the enzymes concerned with peroxide metabolism and changes in the lipid peroxidation pathways. Peroxidase activity from head kidney was estimated in fish treated with certain individual toxicants, mixture of toxicants and a factory effluent, in all of which 100% survival of fish was recorded. In all these treatments, significant inhibition of the enzyme was obtained. Considering the role of peroxidase in peroxide metabolism, inhibition of the enyzme (GPOD) may cause a break in the chain of events. This may lead to an overall imbalance in the homeostatis of the organism. (Baker-IVI)
W86-00429

EFFECT OF SIMULATED SULFURIC ACID RAIN ON THE CHEMISTRY OF A SULFATE-ADSORBING FOREST SOIL,

Pacific Northwest Environmental Research Lab., Corvallis, OR.
J. J. Lee.
Water, Air, and Soil Pollution, Vol. 25, No. 2, p 185-193, June, 1985. 4 Tab, 9 Ref.

Descriptors: *Acid rain, *Water pollution effects, *Forest watershed, *Soil chemistry, Adsorption, Sulfates, Nitrates, Calcium, Magnesium, Hydrogen ion concentration, Zinc.

Acidic deposition can potentially acidify unmanaged forest soils, leading to reduced productivity, tree mortality, and acidification of surface waters. Simulated sulfuric acid rain (pH 3.0, 3.5, 4.0) or control rain (pH 5.6) was applied for 3.5 yr to large lysimeter boxes containing a sulfate-adsorbing forest soil and either red alder or sugar maple seedlings. Elevated sulfate concentrations caused by the simulated sulfuric acid rain were most pronounced for the top 15 cm, but extended down to 45 cm (maple) or 75 cm (alder). No effects of sulfate concentrations were noted at depths of 75 to 90 cm, confirming the existence of a sulfate front between 20 cm and 100 cm. Decreases in Mg and Ca concentrations, base saturation, and soil H were limited to the uppermost 15 cm and, in most cases, to the pH 3.0 treatment. Concentration of Mg and Ca for the pH 3.0 treatments were greater than control at a depth of 15 to 30 cm, indicating transport of the cations from the soil surface. Na and K concentrations, and cation exchange capacity, were not affected by simulated sulfuric acid rain. Elevated concentrations of nitrate and extractable zinc throughout the alder systems indicate either increased rates of symbiotic N-fixation or decreased rates of N immobilization; and mobilization of Zn by all acid rain treatments. Acid deposition at rates typical of the most highly impacted region apparently can cause accelerated loss of bases in the top 15 cm of soil in some presumably insensitive ecosystems. (Baker-IVI)
W86-00430

BIOMASS AND STRUCTURE OF PHYTOPLANKTON IN KONIN LAKES IN THE YEARS 1976-1980,

Polish Academy of Sciences, Lomianki. Inst. of Ecology.
I. Spodniewska.
Ekologia Polska, Vol. 32, No. 2, p 289-305, 1984. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Biomass, *Konin Lakes, *Poland, *Lakes, *Phytoplankton, *Thermal pollution, Water pollution effects, Thermal powerplants, Water cooling, Heated water, Algae, Diatoms, Eutrophication.

Biomass and qualitative structure of phytoplankton were investigated in 4 heated lakes of the cooling system of Konin and Patnow thermal power stations. The lakes joined the cooling system at different times. The lakes vary in morphometry, turbulence, flow and intensity of the effect of heated water. The temperature of surface water in summer reaches the maximum of 27 C. No basic differences were observed in the phytoplankton biomass in lakes varying as to the length of time under the influence of heated water. The greatest phytoplankton biomass was recorded in shallow Goslawskie Lake in summer 1979. Mean phytoplankton biomass between May and September 1978 was also highest in Goslawskie Lake, about 6 mg/liter, and the lowest in the deepest lakes: Slesinskie and Mikorznskie (about 4 mg/l). In deep lakes intensive water blooms were not observed. During summer the phytoplankton biomass of these lakes ranged between 1 and 12 mg/l. The density of planktonic algae was very small in winter despite the high temperature of the water. Diatoms dominated in the plankton of all lakes, but their percentage in total phytoplankton biomass of particular lakes differed considerably. Undoubtedly the heating of Konin lakes results in great numbers of species of green algae in the phytoplankton. The constrained flow of water, especially in Lichenskie Lake, and water turbulence, do not create suitable condition for the intensive growth of this group of algae and for gradual substitution of diatoms by green algae and then by blue-green algae. Under the conditions in the Konin lakes, the great water mobility is undoubtedly a factor limiting intensive phytoplankton growth. (Baker-IVI)
W86-00438

EFFECT OF ZINC ON CADMIUM TOXICITY TO THE AMPHIPOD GAMMARUS PULEX,

Newcastle upon Tyne Univ. (England). Dept. of Zoology.
R. Howell.
Hydrobiologia, Vol. 123, No. 3, p 245-249, April, 1985. 3 Fig, 3 Tab, 23 Ref.

Descriptors: *Cadmium, *Toxicity, *Amphipods, *Zinc, *Estuarine environment, Water pollution effects, Heavy metals.

Because aquatic invertebrates are often exposed to increased concentrations of more than one toxic metal in the environment, antagonism between toxic metals may occur. Gammarus pulex were collected from sites in Northumberland, England and analyzed for total body zinc and cadmium concentrations. The toxicity of cadmium to animals from the different sites was compared with the initial total body zinc and cadmium concentrations of the animals from the site. The toxicity of cadmium to G. pulex was related to the initial total body zinc concentration but not to the initial total body cadmium concentration. In low zinc animals the susceptibility to cadmium poisoning was reduced by exposing the animals to a low concentration of zinc for 14 days. (Baker-IVI)
W86-00446

CONCORDANT VARIATION IN THERMAL TOLERANCE AND ALLOZYMES OF THE RED SHINER, NOTROPIS LUTRENSIS, INHABITATING TAILWATER SECTIONS OF THE BRAZOS RIVER, TEXAS,

North Texas State Univ., Denton. Dept. of Biological Sciences.
T. L. King, E. G. Zimmerman, and T. L. Beitinger.
Environmental Biology of Fishes, Vol. 13, No. 1, p 49-57, May, 1985. 1 Fig, 2 Tab, 43 Ref.

Descriptors: *Shiners, *Thermal pollution, *Thermal tolerance, *Allozymes, *Tailwater, *Brazos River, *Texas, Water pollution effects, Genetics, Dam effects, Stream regulation, Enzymes.

Critical thermal maxima (CTM) and genetic variation were compared for red shiners, Notropis lutrensis, from regulated and unregulated sites on the Brazos River in northcentral Texas. Tailwater fish acclimated to 25 C had significantly lower CTM's than those from a site upstream from the dam and unregulated downstream sites. Significantly different intrasite variances were observed, with two- and four-fold larger CTM variances in fish from within 1 km and 30 km of the dam. Genetic variation was determined from electrophoretic comparisons at 21 structural gene loci. Mean heterozygosity was greatest at regulated sites. Tests for locus heterogeneity at five variable loci indicated that regulated and unregulated populations are not homogeneous. Fish under regulation were genetically more similar to each other than they were to those not affected by regulation. The proportions of the gene variance attributable to habitat alteration were partitioned, and fully one-third of the gene variation was attributed to stream regulation. Patterns of variation in thermal tolerance and metabolic enzymes in the red shiner correlated closely with temperature regimes associated with hypolimnion release from the dam. These adaptive responses have occurred in less than 40 years. (Author's abstract)
W86-00452

ACCUMULATION, ELIMINATION AND CHEMICAL SPECIATION OF MERCURY IN THE BIVALVES MYTILUS EDULIS AND MACROMA BALTHICA,

Odense Univ. (Denmark). Biological Inst.
H. U. Riisgard, T. Kiorboe, F Mohlenberg, I. Drabaek, and P. P. Madsen.
Marine Biology, Vol. 86, No. 1, p 55-62, April, 1985. 5 Fig, 3 Tab, 31 Ref.

Descriptors: *Mercury, *Bioaccumulation, *Mussels, *Clams, *Chemical speciation, Water pollution effects, Organomercury compounds, Mercury compounds, Heavy metals.

Mussels (Mytilus edulis) transferred in net bags from clean to chronically mercury polluted water readily accumulated mercury during an exposure period of three months. Growth of the transplanted mussels had a 'diluting' effect on the mercury concentration, but the absolute weight of mercury uptake increased throughout the entire period, though there was a tendency for decreased efficiency of the removal of mercury per liter of water filtered by the mussels. Mussels were also translocated from polluted to clean (laboratory) water to depurate mercury. The biological half-life of mercury was 293 d for M. edulis from the chronically polluted area in contrast to only 53 d for mussels from a temporary massive mercury polluted area near a chemical deposit. In both cases about 75% of the total mercury in the mussels was inorganic, and it is suggested that both inorganic and organic mercury species were immobilized in mussels from the long-term mercury polluted area, whereas the immobilization capacity was exceeded in the short-term mercury exposed mussels near the chemical deposit. Very slow elimination of mercury was observed in the deposit-feeding bivalve Macoma balthica from the chronically polluted area, and about 6% of the total mercury was methyl- + phenyl-mercury. This is more than three times lower than found in M. edulis from the same collecting site. A pronounced difference in the mercury speciation (i.e., total mercury, total organic mercury, methyl-mercury and phenyl-mercury) in M. edulis from the two mercury polluted areas is thought to reflect the different character of the mercury pollution in the two areas. (Author's abstract)
W86-00453

HEAVY METAL CONTENT OF OYSTER, BLUE MUSSEL AND GROWING WATER IN HANSAN-GEOJE BAY (IN KOREAN),

Fisheries Research an Development Agency, Pusan (Republic of Korea).
G.-C. Hwang, S.-J. Kim, and E.-H. Lee.
Bulletin of the National Fisheries University of Pusan, Vol. 24, No. 1, p 121-128, 1984. 1 Fig, 5 Tab, 21 Ref.

Descriptors: *Heavy metals, *Mussels, *Oysters, *Hasan-Geoje Bay, *Korea, Mercury, Cadmium, Copper, Lead, Zinc, Aquaculture, Shellfish, Water pollution effects.

Quantitative analyses of heavy metals (Hg, Cd. Cu, Pb and Zn) in oyster, Crassostrea gigas, and blue mussel, Mytilus edulis, and growing water associated with hanging cultures in Hansan-Geoje Bay on the south coast of Korea were conducted during the period of July to December 1982. The contents of heavy metals in shellfish by growth, water depth, and species were discussed. Copper content of surface seawater was generally higher than that of five meter deep water with average values of 5.0 and 3.3 ppb, respectively. There were few differences in mercury content between the two water depths with average values of 0.132 and 0.137, respectively. Cadmium, lead and zinc were not detectable. In oysters, copper and zinc content showed a gradually increasing trend with increasing meat weight, whereas there were small variations in cadmium, lead and mercury during the study period; there were no differences between surface and five meter depths. The levels of heavy metals in oyster were consistently higher than that in blue mussel. Heavy metal content of both oyster and blue mussel in Hansan-Geoje Bay in October showed higher metal concentration in shellfish during the study period: The values were 0.55 and 0.21 ppm for cadmium, 6.42 and 0.66 ppm for copper, 0.69 and 0.41 ppm for lead, 101.6 and 18.4 ppm for zinc and 0.009 and 0.006 ppm for mercury, respectively. They were much less than the alert levels for oyster proposed by the Chemical Task Force of U.S. FDA 7th National Shellfish Sanitation workshop in 1977 which were 1,000-2,000 ppm for zinc, 42-175 ppm for copper, 1.5-3.5 ppm for cadmium, 2.0 ppm for lead and 0.2 ppm for mercury. (Author's abstract)
W86-00454

EFFECTS OF METAL SPECIATION ON GROWTH OF PHYTOPLANKTON WITH SPECIAL REFERENCE TO IRON,

Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. de Haan.
Hydrobiological Bulletin, Vol 18, No. 2, p 85-94, December, 1984. 6 Fig, 45 Ref.

Descriptors: *Phytoplankton, *Algal growth, *Metals, *Chemical speciation, *Iron, Lake Tjeukemeer, Netherlands, Ion exchange, Toxicity, Complexation, Chelation, Electrostatic attraction, Diatoms, Eutrophication.

A compilation of studies is reviewed concerning the effects of metal speciation on the growth of phytoplankton. In particular, attention is directed to the speciation and availability of iron in Lake Tjeukemeer, The Netherlands. Free ionic metal species generally appear to be most effective in determining metal availability and toxicity under laboratory conditions. Metal speciation is affected by a variety of factors controlling solubility, ion-exchange, complexation or chelation, sorption and electrostatic attraction of metal ions. Most of these factors result in reduced availabilities. In some cases, particular organic metal chelates such as citrates, nitrilotriacetates and the specifically iron chelating siderophores, are more available than the corresponding free ions. Other metals present also influence the availability of a given metal by competing for the same binding sites on the algal cell. In the eutrophic, alkaline, hard and humic lake Tjeukemeer, the free Fe(3+) concentration is below measurable levels and does not match the iron requirement of the phytoplankton, so most of the algal iron must have been provided by the predominant inorganic iron colloids and particles by dissolution or photodegradation. Different phytoplankton species vary widely in their metal requirements and tolerances. Therefore, metal speciation and availability may affect species composition and succession within phytoplankton communities. (Baker-IVI)
W86-00455

CONTENTS OF CD, FE, MN AND ZN IN THE TISSUE OF KATELYSIA HIANTINA COLLECTED FROM TOLO HARBOUR, AN ALMOST LAND-LOCKED SEA,

Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
M. H. Wong, and K. C. Au.
Hydrobiological Bulletin, Vol. 18, No. 2, p 95-101, December, 1984. 2 Fig, 3 Tab, 27 Ref.

Descriptors: *Clams, *Toxicity, *Heavy metals, *Tolo Harbor, *Hong Kong, Cadmium, Iron, Manganese, Zinc, Sediments, Mine tailings, Water pollution effects.

Samples of Katelysia hiantina (an edible clam) and sediments were collected from iron ore tailings and other nearby sites within Tolo Harbor (Hong Kong) for heavy metal analysis. The water quality of the harbor has deteriorated in recent years due to high inputs of nutrients, and reduced dilution and tidal flushing because of land reclamation and the enclosure of Plover Cove for use as a reservoir. The sediments, as well as the clams at the tailings, contained higher concentrations of Cd, Fe, Mn and Zn. Positive correlations between the metals in the sediments and clam tissues were found. The clams collected from the tailings showed a substantial loss of Fe, Mn and Zn when reared in clean filtered seawater for 8 days. (Baker-IVI)
W86-00456

SURVEY OF THE DISTRIBUTION OF CHIRONOMIDAE (DIPTERA, INSECTA) OF THE RIVER RHINE BY SAMPLING PUPAL EXUVIAE,

Bristol Univ. (England). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-00457

HYPERSCUMS OF THE CYANOBACTERIUM MICROCYSTIS AERUGINOSA IN A HYPERTROPHIC LAKE (HARTBEESPOORT DAM, SOUTH AFRICA),

National Inst. for Water Research, Pretoria (South Africa).
T. Zohary.
Journal of Plankton Research, Vol. 7, No. 3, p 399-409, 1985. 4 Fig, 2 Tab, 35 Ref.

Descriptors: *Microcystis, *Hyperscum, *Scum, *Hartbeespoort Dam, *South Africa, Cyanophyta, Eutrophication, Chlorophyll a, Photosynthesis, Anoxic conditions, Hydrogen ion concentration.

It is proposed that surface scums of densely packed planktonic cyanobacteria (blue-green algae) which exist for weeks to months, measure several decimeters in thickness and are covered by a crust of photo-oxidized cells, be called hyperscums. Hyperscums of Microcystis aeruginosa formed during prolonged periods of calm weather in wind-protected sites in a hypertrophic lake subject to low wind speeds (Hartbeespoort Dam, South Africa). A hyperscum that extended over 1-2 hectares and persisted for 103 days during winter 1983 was studied. Chlorophyll a concentrations ranged from 100 to 300 mg/l. Microcystis cell concentrations reached 1.76 x 10 to the 9th power cells/ml or 116 cu cm/l. The hyperscum environment was anoxic, aphotic, with a fluctuating temperature regime and low pH values. The densely packed Microcystis cells survived these conditions for more than 2 months. This was shown by comparing the potential photosynthetic capacity of Microcystis from the hyperscum with that of Microcystis from the main basin of the lake. However, after 3 months the hyperscum algae lost their photosynthetic capacity and decomposition processes prevailed. The hyperscum gradually shrank in size until a storm caused its complete disintegration. (Author's abstract)
W86-00519

MEIOFAUNA ASSOCIATED WITH MANGROVES IN THE HUNTER RIVER ESTUARY AND FULLERTON COVE, SOUTH-EASTERN AUSTRALIA,

Australian National Univ., Canberra. Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W86-00521

CHANGES OF FLORA AND VEGETATION OF THE CALCAREOUS STREAMS IN THE 'FRIEDBERGER AU' (NEAR AUGSBURG) BETWEEN 1972 AND 1982 UNDER CHANGING POLLUTION CONDITIONS (VERANDERUNGEN VON FLORA UND VEGETATION IN DEN KALKREICHEN FLIESSGEWASSERN DER FRIEDBERGER AU (BEI AUGSBURG) VON 1972 BIS 1982 UNTER VERANDERTEN BELASTUNGSBEDINGUNGEN),

Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Landeskultur und Pflanzenokologie.
A. Kohler, and S. Schiele.
Archiv fur Hydrobiologie, Vol. 103, No. 2, p 137-199, 1985. 9 Fig, 5 Tab, 12 Ref.

Descriptors: *Aquatic plants, *Water pollution effects, *Friedburger Au, *Germany (Federal Republic), Calcareous streams, Wastewater pollution, Vegetation, Macrophytes,.

The Friedberger Au lies in the Lech-Wertach-Ebenen Nature Area in the immediate neighborhood of Augsburg. The flora and vegetation of a calcareous stream in the Friedberger Au was mapped in 1972, 1978 and 1982. Wastewater pollution in the Friedberger Au changed between 1972 and 1982. The most important change was the diversion of wastewater from the city of Friedberg in 1974 to treatment facilities in Lech and Paar. Other communities in the area introduced improved treatment during this period. The alteration of flora and vegetation under changing pollution conditions was studied. Macrophytic recolonization of a formerly overloaded zone took at least 8 years. Some species have not recolonized this part of the stream. Nearby ditches which were initially oligotrophic showed both qualitative and quantitative increases in eutrophic species and decreases in oligotrophic species due to increasing pollution load. (Moore-IVI)
W86-00524

PROBLEM OF SARDINE FISHERIES IN EGYPT,

Institute of Oceanography and Fisheries, Alexandria (Egypt).
N. F. Bishara.
Archiv fur Hydrobiologie, Vol. 103, No. 2, p 257-265, 1985. 2 Fig, 2 Tab, 14 Ref.

Descriptors: *Water pollution effects, *Dam effects, *Sardines, *Commercial fisheries, *Egypt, Nile River, Aswan High Dam, Environmental effects, Wastewater pollution, Plankton.

In Egypt, sardines are caught along the Mediterranean coast from Alexandria to El-Arish with points of concentration at Alezandria, Rosetta, Damietta, Abu Kir bay and Port Said. From 1966 to 1978, there was a marked decrease in sardine landings along the Mediterranean coast of Egypt. Factors responsible for this decline include the construction of the high dam at Aswan in 1964; and increased water pollution by sewage and industrial wastes. The Aswan High Dam greatly reduced the flow of the Nile, and also reduce plankton production in the Mediterranean waters. In the period from 1978 through 1981, sardine fisheries seemed to be thriving once more. (Moore-IVI)
W86-00525

EFFECT OF ADHERENT BACTERIA AND BACTERIAL EXTRACELLULAR POLYMERS UPON ASSIMILATION BY MACOMA BALTHICA OF SEDIMENT-BOUND CD, ZN AND AG,

Geological Survey, Menlo Park, CA. Water Resources Div.
R. W. Harvey, and S. N. Luoma.
Marine Ecology - Progress Series, Vol. 22, No. 3, p 281-289, March, 1985. 2 Fig, 4 Tab, 22 Ref.

Descriptors: *Bacteria, *Exopolymers, *Clams, *Cadmium, *Zinc, *Silver, Sediments, Particulate matter, Bioavailability, Heavy metals, Estuarine environment, Behavior.

Effects of adherent bacteria and bacterial extracellular polymer (exopolymer) upon uptake of particle-bound Cd, Zn and Ag by the deposit-feeding clam Macoma balthica were studied in the laboratory. Amorphous iron oxyhydroxide and unaltered and alkaline-extracted sediments were used as model particulates in separate, controlled deposit-feeding experiments. In general, amounts of metal taken up from ingested particles varied dramatically with the nature of the particle surface. Ingestion of contaminated iron oxide particles did not contribute to overall uptake of Cd and Ag in feeding clams, but accounted for 89 to 99% of total Zn uptake. Exopolymer adsorbed on iron oxide particles caused an increase in the biological availability of particle-bound metals in the order Ag > Cd > Zn, whereas adherent bacteria up to 3.2 x 10 to the 11th/g had no effect upon amounts of metal taken up from ingested particulates. At the higher Cd and Ag concentrations employed (3.6 x 10 to the -7 M), feeding rates declined with increasing amounts of iron oxide-bound exopolymer, suggesting behavioral avoidance due to increased metal availability. Much of the Cd (57%) taken up by clams feeding on unaltered estuarine sediments originated from particulates, even though particle/solute distribution of Cd (86%) was similar to that in experiments with iron oxide particles. Uptake of Cd from alkaline-extracted sediments was insignificant, as it was from unamended iron oxide. However, addition of exopolymer (10 mg/g sediment) caused a restoration in bioavailability of sediment-bound Cd. (Author's abstract)
W86-00528

COMPARISON OF THE TOXIC EFFECTS OF TWO PESTICIDES ON THE TESTES OF A FRESH WATER TELEOST CHANNA STRIATUS BL.,

Government Coll., Mhow (India). Dept. of Zoology.
N. Arora, and S. K. Kulshrestha.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 4, p 435-441, 1984. 3 Fig, 4 Tab, 5 Ref.

Descriptors: *Pesticide toxicity, *Channa, *Carbaryl, *Endosulfan, Toxicity, Fish, Carbamate pesticides, Chlorinated hydrocarbon pesticides, Testes.

A comparative study was made of the toxic effects of sublethal doses of two extensively used pesticides, a carbamate compound carbaryl and an organochlorinated compound endosulfan on the testes of a fresh water teleost, Channa striatus. Male specimens were exposed to 10 and 20 ppm carbaryl and 0.00075 and 0.001 ppm of endosulfan for a period of 30 d. At both dose levels, carbaryl and endosulfan produced the following effects: rupture of the peritoneal lining; rupture of the wall of seminiferous lobules; failure of spermatogenesis at the spermatid stage; necrosis of interstitial cells; and fibrosis of the connective tissue. There was a progressive reduction in different stages of the spermatogenetic activity with an increase in the duration of the exposure. After 30 d of exposure only spermatogonia were seen. (Moore-IVI)
W86-00544

ENVIRONMENTAL BEHAVIOR OF FLUOROTENSIDES; PART 1: WATER TOXICITY TESTING (ZUM UMWELTVERHALTEN VON FLUORTENSIDEN; TEIL 1: PRUFUNG AUF AQUATOXIZITAT),

Akademie der Wissenschaften der DDR, Berlin. Zentralinstitut fuer Organische Chemie.
D. Prescher, U. Gross, J. Wotzka, M. Tscheu-Schluter, and W. Starke.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 6, p 595-600, 1984. 2 Fig, 2 Tab, 9 Ref.

Descriptors: *Surfactants, *Fluorotensides, *Toxicity, Guppies, Algae, Water pollution effects, Water quality standards.

Poecilia reticulata Peters (guppy) and the green alga Monoraphidium griffithii were used for testing of different fluorotensides. After the representation of the methods of investigation and the definition of criteria of toxicity the results obtained by the investigation are discussed. In general, the toxicity of the four investigated fluorotensides to algae was lower than to fish. The anionic fluorotenside CF3-(CF2)n-CFH-COONa was an exception. The results are summarized in tables and diagrams. Finally, for the condition of the receiving-water biocenosis class '2' the respective still permissible matter concentrations are proposed. They vary between 0.05 and 0.2 mg/l. (Author's abstract)
W86-00546

ALDRIN INDUCED CHANGES IN THE ACTIVITIES OF THREE PHOSPHATASES OF MACROBRACHIUM LAMARREI (H. MILNE EDWARDS),

Gorakhpur Univ. (India). Dept. of Zoology.
O. R. Murti, and G. S. Shukla.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 6, p 609-613, 1984. 1 Tab, 24 Ref.

Descriptors: *Aldrin, *Enzymes, *Macrobrachium, Fish, Toxicity, Pesticide toxicity, Metabolism, Stress.

Macrobrachium lamarrei was exposed to 0.008, 0.017 and 0.021 mg/l aldrin (0.4, 0.8 and 1.0 of the LC50,96h) for 24-96h and after exposure the activities of the acid, alkaline and glucose-6-phosphatases are determined. With concentration and time of exposure the acid phosphatases shows an increasing activity up to 170% compared with the control, which is interpreted as part of prenecrotic changes in the cells. With concentration and time of exposure the alkaline phosphatase shows a decreasing activity down to 20% of the control, which is indicative of considerable disturbances of the total metabolism. The glucose-6-phosphatase shows an increasing activity with the aldrin concentration up to 150% during 72 h; then the activity drops to 60-80%. The initial rise in the glucose concentration of blood caused by that is the clear consequence of a stress reaction and the change of metabolism resulting from it. (Author's abstract)
W86-00547

STUDIES ON THE TOXICITY OF SOME INSECTICIDES TO A FRESHWATER TELEOST LEBISTES RETICULATUS (PETERS),

K.L.D.A.V. Coll., Roorkee (India). Dept. of Zoology.
P. K. Gupta, V. S. Mujumdar, and P. S. Rao.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 6, p 629-636, 1984. 4 Tab, 37 Ref.

Descriptors: *Insecticides, *Toxicity, *Lebistes, Fish, Pesticide toxicity, Endosulfan, Lindane, Aldrin, Chlordane, Rogor, Novocrom.

The toxicity of endosulfan, lindane, aldrin, chlordane, rogor and novocrom to the freshwater fish Lebistes reticulatus was investigated for exposure periods of 12-96 h in batch tests with daily exchange of the medium. The mean survival periods and the LC50 were determined. During the early hours of exposure to the insecticides, the opercular movements of the fish decreased. Later the opercular movements increased, and the fish swam erratically, lost balance, and died. Toxicity increases in the following sequence (LC50,96h) (in mg/l): novocron (22.65), rogor (18.97), chlordane (0.341), aldrin (0.017), lindane (0.0160), endosulfan (0.0027). The following safe concentrations in mg/l are recommended: 0.0006 endosulfan, 0.0041 lindane, 0.0010 aldrin, 0.1436 chlordane, 5.4086 rogor and 7.2309 novocron. Presumable safe concentrations of the insecticides to the fish are a fraction of their respective LC50 values and may help to a great extent in determining water quality criteria. (Moore-IVI)
W86-00548

ACUTE TOXICITY OF MERCURIC CHLORIDE AND CADMIUM CHLORIDE TO FRESHWATER PRAWN, MACROBRACHIUM LAMMARREI (H. MILNE EDWARDS),

Gorakhpur Univ. (India). Dept. of Zoology.
R. Murti, and G. S. Shukla.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 6, p 689-692, 1984. 1 Tab, 16 Ref.

Descriptors: *Prawn, *Toxicity, *Mercuric chloride, *Cadmium chloride, Mercury compounds, Cadmium compounds, Behavior, Mortality, Crustaceans.

Toxicity of HgCl2 and CdCl2 in Macrobrachium lamarrei (H. Milne Edwards) was demonstrated in aquarium tests conducted with field-collected Indian specimens over test periods of 24-96 hr. The LC sub 50 for HgCl2 ranged from 0.167 mg/l (24 hr) to 0.095 (96 hr); the respective figures for CdCl2 were 0.374 mg/l and 0.195 mg/l, indicating that CdCl2 is somewhat less toxic. Tests were conducted at pH 7.4 +/- 0.2 and 26 C +/- 1.5 C. Organisms became excited and exhibited spontaneous swimming just after transfer to test solutions of both chemicals, and lost their balance and settled to the bottom very soon in mercuric chloride and after about an hour in cadmium chloride solution. A thin film of mucus was observed in the gill region of CdCl2-exposed prawns, but was not well-marked in those exposed to HgCl2. No mortality was observed up to 96 hr in 0.050 mg/l HgCl2; the comparable figure for CdCl2 was 0.12 mg/l. M lamarrei appears to be the most sensitive of all crustaceans to these two metals, but it is difficult to make comparisons with other species because of differences in temperature optima. (Rochester-IVI)
W86-00553

RELATIVE TOXICITY OF PHENOXY HERBICIDES ON LEBISTES (POECILIA) RETICULATUS (PETERS),

Udaipur Univ. (India). Dept. of Limnology and Fisheries.
H. K. Vardia, and V. S. Durve.
Proceedings of the Indian Academy of Sciences (Animal Sciences), Vol. 93, No. 7, p 691-695, December, 1984. 1 Fig, 1 Tab, 18 Ref.

Descriptors: *Herbicides, *Toxicity, *Lebistes, *Phenoxy herbicides, Aquatic weed control, Pesticide toxicity, 2,4-D, Regression analysis, Dichlorophenoxyacetic acid.

Phenoxy herbicides (2,4-D, its sodium and ethyl amine salts and ethyl esters) commonly used in aquatic weed eradication programs, were tested by acute and static bioassay investigations on a cyprinid fish Lebistes (Poecilia) reticulatus under laboratory conditions. The toxicities of these different formulations are compared and reported in relative toxicity ratings. 'Safe application rate' and 'safe application factor' equations were also calculated. Median lethal concentrations at various time intervals are also reported along with respective fiducial limits and regression equations. Comparative regressions are drawn for three time intervals, 24, 48 and 96 hr. (Author's abstract)
W86-00577

PATTERNS OF BIOACCUMULATION OF AN ESSENTIAL TRACE ELEMENT (ZINC) AND A POLLUTANT METAL (CADMIUM) IN LARVAE OF THE PRAWN PALAEMON SERRATUS,

Institut Francais de Recherche pour l'Exploitation de la Mer, Nantes (France). Lab. Effets Biologiques des Nuisances.
J. Devineau, and C. A. Triquet.
Marine Biology, Vol. 86, No. 2, p 139-143, May, 1985. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Bioaccumulation, *Zinc, *Cadmium, *Prawn, Larval growth stage, Water pollution effects, Heavy metals, Crustaceans.

Palaemon serratus Pennant larvae from females caught near Roscoff (France) of the Bay of Biscay in 1983, were reared in the laboratory. From hatching to the first stage after metamorphosis, the larvae were exposed to zinc and cadmium introduced separately or together into the rearing medium. At the end of experimental contamination, the concentrations of the two metals in the organisms were determined. The level of zinc in organisms was mainly independent of its concentration in the water, suggesting that the bioaccumulation of this essential trace element is controlled by some physiological process. The accumulation of cadmium in the larvae paralleled the overloads of this metal in the water. Increased zinc concentrations in water have little or no effect on the cadmium levels in organisms. The most important interaction between these two metals is an antagonism exerted by cadmium on the biological uptake of zinc. (Author's abstract)
W86-00580

RELATIONS BETWEEN BIOACCUMULATION AND WEIGHT OF ORGANISMS,

Swedish Water and Air Pollution Research Lab., Stockholm.
P.-E. E. Bergner.
Ecological Modelling, Vol. 27, No. 3/4, p 207-220, April, 1985. 6 Fig, 17 Ref.

Descriptors: *Bioaccumulation, *Fate of pollutants, *Aquatic organisms, Accumulation, Metabolism.

Empirical bioaccumulation data indicate the existence of systematic relations between the extensive quantity size of organism and the intensive quantity weight concentration of accumulating substances. The characteristic co-variation between body weight and weight concentration observed in organisms is rationalized on the basis of simple and biologically reasonable postulates. In particular it turns out that the frequently assumed connection between weight concentration and age is not a prerequisite in order to explain the observed phenomenon. The basic principles to be applied are that a change in an organism's size does not directly alter the metabolism of the individual cells, and that usually the total uptake of most substances by an organism increases with the organism's size. The conclusion is drawn that, when working on problems that involve bioaccumulation processes, the absolute size of organisms should be included in the analysis, no matter what specific model is applied. (Baker-IVI)
W86-00594

PHYSIOLOGICAL RESPONSES TO POLLUTION,

Institute for Marine Environmental Research, Plymouth (England).
J. Widdows.
Marine Pollution Bulletin, Vol. 16, No. 4, p 129-134, April, 1985. 2 Fig, 31 Ref.

Descriptors: *Water pollution effects, *Physiological ecology, Physiological responses, Aquatic animals, Monitoring, Toxicology.

The measurement of changes in the physiological responses of individual organisms should form an important component of any toxicological or environmental monitoring program. The rate of growth is a fundamental component of physiological fitness and therefore represents an important index of environmental (pollutant) effect. An additional index can be calculated from the physiological components of the energy equation in order to provide further information on the efficiency with which an animal functions. Shell growth measurement, where appropriate, can serve to integrate and record changes in environmental quality over a period of weeks or months. Reproductive processes form a critical interface between the individual and the population. Behavioral responses, including bivalve shell gape and rate of byssal attachment have been suggested as simple methods of monitoring changes in environmental quality, but they are generally difficult to quantify and interpret. In order to calculate the assimilative capacity (or rate) of receiving waters by means of environmental quality models it is necessary to identify toxic contaminants, identify and characterize the sources and sinks of contaminants, identify the key resource to be protected, and establish dose-response relationships for relevant contaminants and appropriate target organisms. Physiological measurements of pollution impact therefore have an important role in environmental pollution monitoring. (Baker-IVI)
W86-00597

ASSESSMENT OF THE BIOLOGICAL EFFECTS OF SEWAGE SLUDGE AT A LICENSED SITE OFF PLYMOUTH,

Water Research Centre, Marlow (England).
T. J. Lack, and D. Johnson.
Marine Pollution Bulletin, Vol. 16, No. 4, p 147-152, April, 1985. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Water pollution effects, *Sludge disposal, *Plymouth, *England, Marine pollution, Toxicity, Mussels, Metals, Enzymes.

Mussels were placed in cages at sites were chosen to lie along a hypothetical pollution gradient. Two cages were held 4 m below the surface and two 4 m above the sea bed. The depths of water ranged from about 10 m at Site 1 to about 60 m at Site 7. There is an indication that animals in the upper cages were more stressed by the sewage disposal than animals in the lower cages. The lowest scope for growth (SFG) was found in the upper animals at site 5 on the edge of the sludge disposal ground, with significant improvements in SFG moving inshore to site 1 and offshore to site 7. Of the upper animals, those at sites 2, 3, 5, and 6 had significantly lower SFG than at site 1. There was no significant difference between the lower animals except those at site 2, where the lowest SFG was recorded. Concerning lysosomal stability, all the animals from the upper cages showed significantly more stress than the control animals. For the animals contained within the upper cages the most stressful site was at the center of the disposal ground, with progressively less stress being detected at the sites away from the ground. The inshore site was the least stressful for both upper and lower animals although only two sections of the lower animals were assayed. The upper caged animals had elevated levels of organic detoxication enzymes and there was evidence of two possible sources of stress; land based or estuarine inputs affecting animals near the shore at sites 1 and 2 and sewage sludge affecting animals around the disposal ground at sites 5, 6, and 7. The lower cages anmials showed evidence that a metal detoxication system had been induced. It appeared that two sources may be involved; land-based, estuarine and metal-enriched sediments affecting the near shore and shallower sites and sewage sludge affecting those animals closest to the disposal ground. (Baker-IVI)
W86-00599

FISH GILL STRUCTURAL CHANGES INDUCED BY TOXICANTS AND OTHER IRRITANTS: A STATISTICAL REVIEW,

Washington State Univ., Pullman. Dept. of Zoology.
J. Mallatt.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 630-648, April, 1985. 1 Fig, 7 Tab, 130 Ref.

Descriptors: *Water pollution effects, *Fish, *Gills, *Reviews, Toxicity, Histology, Pathology, Irritants, Statistical studies, Morphology, Osmolality, Ultrastructure.

The literature on how fish gill morphology is affected by chemical and physical irritants in the surrounding water (e.g. various toxicants, extremes of temperature or pH) is quantitively reviewed. Histopathological gill lesions that were reported are catalogued, and statistics are to explore how such lesions relate to the irritant-exposure conditions under which they occurred (specifically, to dose and class or irritant, to temperature, and to salinity of the surrounding water). Frequently recorded histopathologic lesions include changes in gill epithelium (lifting, necrosis, hyperplasia, rupture), bulbing or fusing of gill lamellae, hypersecretion and proliferation of mucocytes, and changes in chloride cells and gill vasculature. It is concluded that these lesions are largely nonspecific in nature, as each was detected under many different exposure conditions. The lesions are not entirely independent of exposure conditions, however, as the statistical analysis discerns these trends: (1) Most gill lesions types have been reported more frequently after lethal than after sublethal exposure of irritants. (2) Some lesions were more frequently detected in studies employing heavy metals than in studies using organic toxicant or other irritants; such lesions include necrosis and hypertrophy of gill epithelial cells, plus mucous hypersecretion. (3) Lifting of the branchial epithelium, the most commonly reported lesion, was reported more often in freshwater than in marine fish, suggesting the osmolarity of the ambient water influences this lesion. Little relation was found between recorded lesion frequencies and temperature. Following the statistical analysis, the etiology of irritant-induced gill lesions is considered. The nonspecificity, of branchial alteration suggests that they primarily represent sterotyped physiological reactions of gills to stress, and many of them are logically considered defense responses. Some branchial alterations have been considered inflammatory, but it is concluded that the literature cannot support that hypothesis. Ultrastructural studies have detected irritant-induced disruptions of branchial epithelial cells, including cytoplasmic vacuolization, autophagosomes and inclusions, loss of microvilli, and abnormal mitochondria and nuclei. (Author's abstract)
W86-00602

WHOLE-LAKE FERTILIZATION EXPERIMENTS IN COASTAL BRITISH COLUMBIA LAKES: EMPIRICAL RELATIONSHIPS BETWEEN NUTRIENT INPUTS AND PHYTOPLANKTON BIOMASS AND PRODUCTION,

Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
J. G. Stockner, and K. S. Shortreed.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 649-658, April, 1985. 7 Fig, 2 Tab, 37 Ref.

Descriptors: *Nutrients, *Phytoplankton, *Biomass, *Lakes, *British Columbia, *Fertilization, Monomictic, Nitrogen, Phosphorus, Trophic level, Nutrients, Chlorophyll.

Seventeen warm monomictic coastal lakes in British Columbia were studied from 1980 to 1983. Inorganic nitrogen and phosphorus were applied to 13 of the lakes in some or all years of the study. In the untreated condition, lakes were ultraoligotrophic with low concentrations of nutrients (1.0-4.1 micro-g total P/L at spring overturn), of average summer chlorophyll (0.49-2.57 micro-g/L), and of average daily primary production (3.0-10.5 mg C/cu m/d). The lakes' oligotrophic condition is sustained by their low residence time (0.2-7.3 yr) and by low nutrient inputs from the generally steep granitic drainage basins. The lakes respond predictably to nitrogen and phosphorus additions and are generally phosphorus limited, as shown by the significant positive relationships between average summer chlorophyll and total phosphorus at spring overturn (r sq = 0.81) in unfertilized lakes, between average summer chlorophyll and phosphorus load from fertilizer (r sq = 0.62) in fertilized lakes, by the high average particulate C:N:P ratios (152:20:1), and by the high average TN:TP ratio (89). (Author's abstract)
W86-00603

ACIDIFICATION EFFECTS ON STREAM BIOTA AND ORGANIC MATTER PROCESSING,

Michigan State Univ., East Lansing. Dept. of Zoology.
T. M. Burton, R. M. Stanford, and J. W. Allan.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 669-675, April, 1985. 2 Fig, 5 Tab, 19 Ref.

Descriptors: *Stream biota, *Organic matter, *Acidification, Water pollution effects, Decomposition, Leaves, Detritus, Invertebrates, Acid streams, Aquatic insects, Isopods, Snails, Mortality.

Experimental acidification effects on stream biota and organic matter decomposition rates in natural, low alkalinity (7-15 mg CaCO3/L) Michigan streams were studied using paired, artificial, recirculating streams. Acidification to pH 4 with sulfuric acid from pH 7.0 to 7.4 resulted in significant decreased decomposition rates for 5-g leaf packs of white birch (Betula papyrifera) and sugar maple (Acer saccharum). Populations of total macroinvertebrates on leaf packs in the acid stream substantially reduced over a 264-d exposure period, whereas populations remained unchanged in the control stream. Detailed studies were conducted on a caddisfly, Lepidostoma liba, and an isopod, Asellus intermedius. The Lepidostoma population was resistant to short-term exposure to acidification, but significant mortality occurred after 80 d at pH 4 at 2-4 C. Late instars were not affected by acidification and emerged after more than 60 d at 15-20 C. Asellus was very sensitive to acidification with up to 93% mortality after only 24 d and with inhibition of reproduction. Acidification also reported in increased mortality for a snail, Physa heterostropha, and another caddisfly, Pycnopsyche sp. (Author's abstract)
W86-00604

DEPTH DISTRIBUTION AND BIOMASS OF SUBMERSED AQUATIC MACROPHYTE COMMUNITIES IN RELATION TO SECCHI DEPTH,

McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W86-00606

INFLUENCE OF PH, WATER HARDNESS, AND ALKALINITY IN THE ACUTE LETHALITY OF ZINC TO RAINBOW TROUT (SALMO GAIRDNERI),

Guelph Univ. (Ontario). Dept. of Zoology.
R. W. Bradley, and J. B. Sprague.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 731-736, April, 1985. 1 Fig, 2 Tab, 38 Ref.

Descriptors: *Toxicity, *Zinc, *Trout, *Hydrogen ion concentration, *Alkalinity, *Hardness, Water pollution effects, Mortality, Carbonates, Chemical precipitation, Dissolved solids.

The acute lethality of dissolved zinc to rainbow trout (Salmo gairdneri) was significantly increased

at higher pH and lower hardness levels. Changes in pH from 5.5 to 7.0 increased zinc toxicity by factors to 2 to 5, depending on total hardness levels. A decrease in hardness from 386 to 31 mg CaCO3/L increased zinc toxicity by more than an order of magnitude at both pH levels. These effects of pH and hardness were not caused by changes in the chemical speciation of zinc. An increase in carbonate alkalinity from 8.4 to 24 mg CaCO3/L at pH 7.0 did not significantly alter zinc toxicity at either hardness level. Thus, carbonate alkalinity is not an important factor at or below pH 7.0. At low hardness, dissolved zinc was more than 10 times as toxic at pH 9.0 as at pH 5.5. Two competing mechanisms appear to operate: as the pH rises, dissolved zinc becomes increasingly toxic, but at higher pH levels it is increasingly replaced by zinc precipitate, which is of very low toxicity to fish. (Author's abstract)
W86-00608

POSTSETTLEMENT DIATOM SUCCESSION IN THE BAY OF QUINTE, LAKE ONTARIO,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
E. F. Stoermer, J. A. Wolin, C. L. Schelske, and D. J. Conley.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 754-767, April, 1985. 9 Fig, 2 Tab, 30 Ref. EPA grant R810396, NSF grant OCE-8216588.

Descriptors: *Diatoms, *Succession, *Bay of Quinte, *Lake Ontario, *Ontario, History, Eutrophication, Silica, Fossils, Chrysophyta, Mining, Water pollution effects.

Siliceous algal microfossil assemblages deposited in the Bay of Quinte prior to European settlement consist of low numbers of benthic diatoms and chrysophyte cysts. Early settlement activities are marked by qualitative changes in the flora and small increases in microfossil flux. Events associated with the Ambrosia horizon produced a rapid transition from assemblages characteristic of oligotrophic environments to those characteristic of eutrophic waters and a large increase in microfossil flux. This was followed by a period of decreasing siliceous microfossil flux and reestablishment of less eutrophic species ca. 1853-61. Minimum siliceous algal microfossil flux and highly atypical assemblages occurred in the period ca. 1879-88, which corresponds to the period of intensive mining activities in the Bay of Quinte watershed. Maximum flux of siliceous microfossil occurred ca. 1900 and declined thereafter, although composition of assemblages deposited indicates increasing eutrophy and displacement of summer-blooming species. This is interpreted as evidence of beginning of summer silica limitation. Based on microfossil evidence, the modern eutrophic flora of the bay was established by 1928. (Author's abstract)
W86-00609

EFFECTS OF LOW ENVIRONMENTAL PH ON THE SURVIVAL, GROWTH AND IONIC COMPOSITION OF POSTEMERGENT ATLANTIC SALMON (SALMO SALAR),

Department of Fisheries and Oceans, St. Andrews (New Brunswick). Fisheries Research Branch.
G. L. Lacroix, D. J. Gordon, and D. J. Johnston.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 768-775, April, 1985. 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Salmon, *Hydrogen ion concentration, *Water pollution effects, Immature growth stages, Bioassay, Mortality, Growth, Calcium, Sodium, Westfield River, Nova Scotia.

Postemergent Atlantic salmon (Salmo salar) were reared during the early feeding phase in the soft, acidic water of the Westfield River (mean pH 5.0) in Nova Scotia. The fry were held in a flow-through system of tanks in situ and were fed a hatchery diet. Bioassays were also conducted in river water treated with limestone (mean pH 6.1) to provide a control. Cumulative mortality of fry after 30 d in the tanks was 70% at pH 5.0 and only 4% at pH 6.1. Fry in untreated river water were inactive, ingested little food, and lost weight (approximately 25%) during the first 15 d of exposure. Large increases in body (Ca(2+)) and (Na(+)) were observed in fry at both pH levels during that time, but the increase in (Ca(2+)) lagged and that in (Na(+)) was less in fry at low pH. Deaths occurred 15-30 d after swim-up and dead fry were all severely emaciated, indicating the deaths were probably from starvation. Although there were differences in ionic composition changes in fry held at pH 5.0 compared with control, no major depletion of body ionic reserves occurred relative to initial concentrations. Surviving fry a pH 5.0 developed a tolerance after 25 d and had growth rates, condition factors, and ionic concentrations similar to those to fry in treated water. The mortality of fry during the transition to exogenous feeding, in response to low pH stress in soft water, is probably responsible for reduced recruitment and the decline or loss of salmon stocks in this and other acidic rivers of Nova Scotia. (Author's abstract)
W86-00610

5D. Waste Treatment Processes

INNOVATIVE/ALTERNATIVE WASTEWATER COLLECTION SYSTEMS FOR CORPS OF ENGINEERS RECREATION AREAS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
M. J. Cullinane.
Miscellaneous Paper EL-81-7, September 1981. 36 p, 10 Ref.

Descriptors: *Wastewater treatment, *Wastewater collection, *Sewer systems, *Septic tanks, *Recreation facilities, Wastewater disposal, Pressure sewer systems, Vacuum sewer systems, Gravity flow.

Design considerations are given for several wastewater collection and transmission alternatives for recreation areas. Choice of a system is site-specific. The conventional gravity collection system is easy to maintain, expand, and operate; however, capital costs are high, especially if terrain or excavation problems exist. Pressure systems are of two types: (1) GP, which has a holding tank, grinder pump, electrical and mechanical components, and collection system piping and (2) STEP, which has a septic tank, one-site pressurization unit, and collection system piping. Vacuum systems have a central vacuum source to maintain a constant vacuum on the main line of the collection systems. Small-diameter gravity systems, not widely used in the U.S., include on-site septic tanks that drain into small-diameter gravity sewers. Cost information is provided for each system.
W86-00331

MEMBRANE CONTROLLED PROCESSES FOR THE ENERGY-EFFICIENT CONVERSION OF SLUDGES TO FUELS AND MARKETABLE CHEMICALS.

Columbia Univ., New York.
Available from the National Technical Informatin Service, Springfield, VA 22161 as DE82013685. Department of Energy, Washington, DC. Office of Renewable Technology. Report DOE/CS/20400-1. March 1982. 254 p. 69 Fig, 26 Tab, 106 Ref. Contract/Grant No. DE-AC01-78CS20400.

Descriptors: *Wastewater treatment, *Byproducts, *Membrane processes, Anaerobic digestion, Aerobic treatment, Sludge digestion, Municipal wastes, Solid wastes.

The development of a process for the membrane-controlled conversion of urban solid wastes and sludges into fuels and marketable chemicals is reported. It is highly cost-effective and energy efficient because of the substantial value of the chemical by-products obtained. Sludges are concentrated to permit smaller fermenters and are then fermented rapidly and efficiently under membrane control. All the undesirable by-products are converted into useful chemicals such as liquid ammonia and organic acids. This is followed by a secondary aerobic fermentation to obtain the virtually complete destruction or conversion of all organic matter to chemical by-products. This system is highly compact and capable of being placed into operation at sewage treatment plants to effect a virtually closed-loop operation.
W86-00361

MARKET ASSESSMENT AND TECHNOLOGICAL EVALUATION OF THE CPU-4000 CHEMICAL PRECIPITATION UNIT,

Battelle Columbus Labs., OH.
J. L. Means, N. D. Gregorich, and E. W. Helper.
Final Report, October 25, 1983. 33 p, 1 Fig, 8 Tab, 26 Ref, Append.

Descriptors: *Heavy metals, *Metal-finishing wastes, *Separation techniques, *Chemical precipitation, *Wastewater treatment, Marketing, Effluent limitations, *Industrial wastewater, Industrial wastes, Metals, Comparison studies.

A market assessment of the CPU-4000, a device which can be used as a pollution control mechanism for heavy metals in industrial effluents is given along with a comparison of CPU-4000 technology with that of other metal removal techniques. A target market for the CPU-4000 ranging from 23,828 to 23,891 firms was identified. In the metal finishing industry, 5,060 markets are identified; and in the photofinishing industry, 5,500 markets are attributed to hospitals and 9,801 markets are attributed to graphic art firms. Photographic processing accounts for 1,667-1,730 markets for CPU-4000 technology while non-destructive testing, used in such industries as aerospace, oil pipelines, and nuclear science accounts for 1,800 markets. EPA discharge regulations for the electroplating and metal finishing industries limit cyanide, Pb, Cd, Cu, Ni, Cr, Zn and Ag for plants with a daily flow of 38,000 liters and Pb, Cd, and cyanide for plants with a daily flow of < 38,000 liters. The sodium sulfide precipitation technique is considered extremely effective for treating wastewater containing toxic metal ions. The CPU-4000 which embodies the sodium sulfide precipitation technique can remove up to 30 different metal ions whereas electrolytic deposition, metallic replacement and ion exchange are generally effective in removing only a single metal ion.
W86-00386

DIGESTION OF FORMALDEHYDE BY ADAPTED BACTERIA (ZUM ABBAU VON FORMALDEHYD DURCH ADAPTIERTE BAKTERIEN),

Karl-Marx-Univ., Leipzig (German D.R.). Sektion Biowissenschaften.
U. Behrens, and J. Hannes.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 1, p 39-45, 1984. 3 Fig, 18 Ref.

Descriptors: *Formaldehyde, *Biological wastewater treatment, *Bacteria, Wastewater treatment, Activated sludge process.

Municipal activated sludge was cultivated in a medium composed of formaldehyde, glucose and mineral salts. By passages with increasing formaldehyde concentrations, a bacterial culture was selected which remained active at initial concentrations of 1 g/l formaldehyde. With this culture, formaldehyde and glucose were oxidized simultaneously to formate and gluconate, which subsequently served as substrate for the growth of bacteria. Glucose alone was also oxidized to gluconate, which then was used as substrate for growth. Formaldehyde alone was only oxidized. If the actual formaldehyde concentration was kept low, however, by fed-batch cultivation, it was assimilated through formate formation. The biochemical background and the importance of the findings for the purification of formaldehyde-containing wastewaters are discussed. (Author's abstract)
W86-00397

OCCURRENCE OF R-PLASMIDS IN ESCHERICHIA COLI AND COLIFORM GERMS FROM WATER AND WASTEWATER; PART 2: METHODS OF ISOLATION OF R+ -BACTERIA FROM SURFACE AND WASTEWATER, THE

TRANSFER OF THEIR R-PLASMIDS AS WELL AS THE DETERMINATION OF THE RESISTANCE IMAGES (UBER DAS VORKOMMEN VON R-PLASMIDEN IN ESCHERICHIA COLI UND KOLIFORMEN KEIMEN AUS WASSER UND ABWASSER; TEIL 2: METHODEN DER ISOLIERUNG VON R+ - BACTERIEN AUS OBERFLACHEN - UND ABWASSER, DES TRANSFERS IHRER R-PLASMIDE SOWIE DIE BESTIMMUNG DER RESISTENZBILDER),
Institut fur Experimentelle Epidemiologie, Wernigerode.
H. Heier, and H. Tschape.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 1, p 47-54, 1984. 4 Tab, 14 Ref.

Descriptors: *Escherichia, *Coliforms, *Plasmids, *Wastewater, *Surface waters, Bacteria, Hospitals, Antibiotic resistance, Municipal wastewater, Effluents, Wastewater treatment facilities.

A detailed description is given of methods for the isolation of R+ bacteria from water and wastewater, the determination of their resistance pattern and the transfer of R-plasmids from wild strains to Escherichia coli K 12. Results are given of investigations on the inflows and outflows of municipal and rural clarification plants as well as of a special hospital for lung-diseases and a urological clinic. It was found that coliform bacteria with a threefold and fourfold resistance were dominant in wastewater and surface water and that there was a pronounced shift to strains with a multiple resistance in hospital sewage. The values for the quotient of the single resistance in coliform germs from the wastewater of a lung-disease sanatorium and of germs with multiple resistance in the wastewater from an urological clinic were particularly high. As can be demonstrated, the selective pressure of the different chemotherapeutic agents used for the therapy is effective. (Author's abstract)
W86-00398

ELIMINATION AND RECOVERY OF METAL IONS FROM WASTEWATER - A SURVEY (ELIMINIERUNG UND RUCKGEWINNUNG VON METALLIONEN AUS ABWASSERN - EINE UBERSICHT),

Technische Hochschule 'Carl Schorlemmer' Leuna-Merseburg (German D.R.).
R. Kummel, F. Winkler, and R. Beck.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 3, p 227-237, 1984. 6 Fig, 16 Ref.

Descriptors: *Heavy metals, *Wastewater treatment, Metals, Ion exchange, Recycling, Membrane processes, Chemical treatment, Ultrafiltration.

The present state and the trends in the recovery of heavy metals from wastewaters are presented. The classical precipitation techniques are unsatisfactory due to increases in solubility in the presence of impurity ions and/or complexing agents. At present, ion-exchange processes constitute the most frequently used method of metal recycling with an effective enrichment of metal ions. For the effective separation of metals from solutions of a low concentration, electrolytic reduction demands large electrode surface areas. In cells with fixed-bed or fluidized cathodes one can obtain specific electrode surface areas of some 1000 sq m/cu m. For the future, processes of extraction and especially membrane separation will gain in importance. In the past few years, a large number of highly selective metal extracting agents as well as liquid membrane permeation with suitable carriers were developed. Combinations of membrane separation processes with chemical reactions may attain the same importance, as e.g. ultrafiltration in connection with the fixation of metal ions to water-soluble polymers. In the long run, techniques will prevail which will not only result in metal enrichment but also in the recovery of the raw material water. (Author's abstract)
W86-00410

POSSIBILITIES OF THE CORRELATION OF DIFFERENT WATER ANALYSIS METHODS (MOGLICHKEITEN DER KORRELATION UNTERSCHIEDLICHER WASSERANALYSENVERFAHREN),

Technische Hochschule 'Carl Schorlemmer' Leuna-Merseburg (German D.R.).
For primary bibliographic entry see Field 5A.
W86-00411

POSSIBILITIES OF THE AFTERPURIFICATION OF WASTEWATERS FROM THE PRODUCTION OF ARTIFICIAL LEATHER WITH THE AID OF ALGAE. PART 2 (MOGLICHKEITEN DER NACHREINIGUNG VON ABWASSERN AUS DER KUNSTLEDERPRODUKTION MIT HILFE VON ALGEN, TEIL 2),

Ceskoslovenska Akademie Ved, Trebon. Dept. of Hydrobotany.
J. Chromek, J. Kupec, P. Marvan, and M. Mladek.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 5, p 521-530, 1984. 5 Fig, 3 Tab, 6 Ref.

Descriptors: *Biological wastewater treatment, *Industrial wastewater, *Algae, *Artificial leather industry, Wastewater treatment, Dimethylamine, Phosphorus, Nitrogen, Scenedesmus.

An attempt was made to use the alga Scenedesmus quadricauda for the purification of wastewaters from the production of artificial leather. The dimethylamine contained in these wastewaters is continuously decomposed and the remaining nitrogen-containing residuals are used as a nutrient source for the production of algal biomass. In continuous experiments with wastewaters, dimethylamine and its metabolites showed a pronounced inhibiting effect. In practice, a longer retention time in the reactors as well as a sufficient proportion of municipal wastewater are required in order to avoid a limiting of growth due to a phosphorus deficiency. Information is given on other investigations performed on the purification of artificial leather wastewaters with the aid of the biological nitrogen elimination under specific conditions with a successful denitrification of up to 95%. (Author's abstract)
W86-00418

MIXING CHARACTERISTICS AND PERFORMANCE OF THE ANAEROBIC UPFLOW BLANKET FILTER (UBF) REACTOR,

Biotechnology Research Inst., Ottawa (Ontario).
R. Samson, and S. Guiot.
Journal of Chemical Technology and Biotechnology, Vol. 35B, No. 1, p 65-74, March, 1985. 5 Fig, 4 Tab, 17 Ref.

Descriptors: *Upflow blanket filter, *Mixing, *Wastewater treatment, Chemical oxygen demand, Filtration, Anaerobic digestion, Biological wastewater treatment.

Mixing characteristics (using a radioactive tracer) and reactor performance of the upflow blanket filter (UBF) reactor operated at different loading rates (up to 32 kg chemical oxygen demand (COD)/cu m/day) were compared. The results indicated that mixing profiles of the reactor operated with effluent recirculation and without biomass were of the perfectly mixed type. Operation without recirculation resulted in about 18% dead space. The filter made of plastic rings and located in the top third of the reactor had no negative effect on reactor mixing. Operation at loading rates of up to 25 kg COD/cu m/day permitted a soluble COD removal rate of 95% with a methane production rate of 5.9 cu m/cu m/day. At higher loading rates, the efficiency of COD reduction decreased with a decrease of the specific acetoclastic activity to 0.5 kg acetate removed per kg volatile suspended solids (VSS)/day. At all loading rates studied it was observed that the performance was not related to the mixing characteristics, which had remained of the perfectly mixed type with an occasional small dead space (below 10%). The good mixing characteristics of the UBF reactor coupled with the high biomass content and the effective action of the filter make this reactor one of the most promising designs for the treatment of soluble wastes. (Author's abstract)
W86-00423

ALGAL-BIOMASS RACEWAY SYSTEM FOR PARTIALLY TREATED SWINE WASTEWATER IN THE TROPICS,

Hawaii Univ. at Manoa, Honolulu. Dept. of Agricultural Engineering.
P. Y. Yang, and S. Y. Nagano.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 2, p 542-546, March/April, 1985. 4 Fig, 6 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Animal wastes, *Algal-biomass raceway system, Tropical regions, Farm wastes, Ammonia, Biochemical oxygen demand.

The algal-biomass raceway system for growth of mixed algae and bacteria from anaerobically digested effluent and settled supernatant of raw swine wastewater was compared with three other stabilization processes on the basis of BOD5 loading rates, percent removal efficiency and energy consumption of kilowatt hour input per Kg removal of BOD5. The four aerobic systems were oxidation ditch, algal-biomass raceway, facultative oxidation pond, and aerated lagoon. The oxidation ditch and algal-biomass raceway accommodate much higher BOD5 loading rates than either the facultative oxidation pond or aerated lagoon. Overall removal efficiencies were generally good for all four systems. The algal-biomass system most closely resembles the aerated lagoon in removing BOD5 since both have similar energy consumption values. The main advantage of the algal biomass system over the aerated lagoon system is the nearly three-fold higher BOD5 loading rate that can be used. Another advantage of using algal-biomass systems is in removing NH4-N. Its removing efficiency is 65.8% at a loading rate of 0.029 g/L/day. Its removal efficiency is within the range of 40-80% reported for the oxidation ditch and slightly higher than the 60% of the aerated lagoon. In addition, the algal-biomass raceway system provides a lower land requirement for treatment, except for the oxidation ditch. The algal-biomass raceway can handle almost three times the BOD5 loading rate applied to the aerated lagoon, yet uses only two-thirds the land area. (Baker-IVI)
W86-00482

STUDIES OF THE HYDRODYNAMIC PROPERTIES IN BIOLOGICAL CLARIFICATION PLANTS USING RADIOTRACERS,

Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung.
H. G. Koennecke, D. Luther, K. Koepping, J. Schoen, and H. Ulrich.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 4, p 431-434, 1984. 5 Fig, 6 Ref.

Descriptors: *Biological wastewater treatment, *Hydrodynamics, *Radioactive tracers, Wastewater treatment, Bromine radioisotopes, Activated sludge process, Optimization, Mathematical studies.

Employment of Br-82 as a tracer, combined with mathematical analysis of results, was used to optimize performance of two sewage treatment plants in the German Democratic Republic. The first plant studied involved two pools, of which the first, an activated sludge chamber with an aeration impeller, a volume of 7,670 cu m, and a inflow of 730 cu m per hr, was analyzed. The second plant had a throughput of 100,000 cu m per day, and comprised 8 activated sludge chambers of 4,000 cu m volume each. Aeration in the second plant was accomplished by tubes placed side-by-side, 70 cm apart, in the activated sludge chambers. Pool I was shown to be an ideal mixing reactor based on the equation c=c sub 0 . e (-/MRT), in which c sub 0 = initial concentration and MRT = mean residence time. Reversing the impeller's direction of rotation induced a reduction of the by-pass flow of 50%, resulting in improved efficiency in the activated sludge chamber. In plant II, MRT during maximal throughput (625 cu m per hr in each activated sludge chamber) is 374 min, but is only 355 min during minimal throughput (125 cu m per hr). Neither by-pass flow nor wake space were found. MRT was abnormal with respect to

throughput in this chamber, so that the regeneration volume in the chamber will be used for degradation of the contents of the sewage during minimal throughput. Movement of the sewage inlet to the front side of the chamber results in a 20% increase in throughput, with a resulting energy saving of 3.5 x 1,000,000 kWhr/a. (Rochester-IVI)
W86-00543

MODEL OF A BACTERIAL CULTURE UTILIZING A TOXIC SUBSTRATE IN CONTINUOUS FLOW CONDITIONS,

Bulgarian Academy of Sciences, Sofia. Inst. za Yadrena Izsledvaniya i Yadrena Energetika.
For primary bibliographic entry see Field 5B.
W86-00549

EPA DEBATES SWITCH FROM THE CARROT TO THE STICK IN SEWAGE TREATMENT,

R. L. Stanfield.
National Journal, Vol. 17, No. 6, p 312-316, February, 1985.

Descriptors: *Wastewater treatment facilities, *Legislation, Funding, Construction, Water pollution control, Loans, Grants, Pretreatment, Urban areas.

In 1985, Congress must determine the federal government's role in water treatment when the federal program that presently contributes a large fraction of the money for treatment plant construction expires on September 30. Originally, the law offered funds to municipalities to help with construction of plants as a way to gain their cooperation in compliance. Great strides have been made since the 1960's in cleaning up household and commercial wastes, particularly in small localities. From 1970, before the federal grant program was started, to 1982, however, the contribution of municipalities and states for wastewater projects has dropped from $2.3 billion to less than $1 billion for projects that received no federal aid. Bills are before Congress to hold the federal contribution for construction to the present $2.4 billion annually or to increase the size of the program. Another idea is to convert the program from grants to a revolving loan program. Large cities, which have not benefitted as much as smaller ones under the existing program because of the difficulties of getting started on larger projects, now complain that the program should not be cut back just when they are ready to begin construction. An additional problem to be faced is what to do about toxic discharges, which originate largely in industry and were not considered an issue when the original Clean Water Act facilities grants program was designed. Some cities wish to opt out of the present federal pretreatment program, which is just now getting underway, and create their own programs based on performance criteria rather than the Environmental Protection Agency's (EPA) 'best available technology' approach. Failure of many cities to submit pretreatment plans on time has necessitated an increase in EPA enforcement activity. (Rochester-IVI)
W86-00559

5F. Water Treatment and Quality Alteration

ION-SELECTIVE ELECTRODES (ISE) - RESEARCH INTO THE POTENTIAL REGULATION AND APPLICATION IN ANALYSIS (IONENSELEKTIVE ELEKTRODEN (ISE) - UNTERSUCHUNGEN ZUR POTENTIALEINSTELLUNG UND ANWENDUNG IN DER ANALYTIK),

Technische Hochschule 'Carl Schorlemmer' Leuna-Merseburg (German D.R.).
For primary bibliographic entry see Field 5A.
W86-00395

PHYSICO-CHEMICAL CHARACTERISTICS OF THE USED FILTER SAND AND ITS ROLE IN THE SEVEN WATER WORKS SYSTEM IN A TROPICAL REGION,

Bhopal Univ. (India). School of Biological Science.
D. Y. Prasad, and D. K. Belsare.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 1, p 73-80, 1984. 5 Tab, 8 Ref.

Descriptors: *Water treatment, *Sand filters, *Tropical regions, India, Filters, Particle size, Backwash, Filter regeneration.

The filter-technique equipment of seven water works in a tropical region of India is described. The structure of the filter sand layer, the grain size distribution and the degree of uniformity are compared by means of tables. The uniformity coefficient of a good filter sand is smaller than 1.7. Besides physical properties, also the surface properties of the filter sand grains are of interest. Different analytical methods for determining the incrustation are described. The amount of the filter grain load also depends on age, that is, on the service life of the filter sand. The efficiency of a filter plant is determined also by the regenerating process, that is, by back-wash. This includes the methods of scouring with water only and the backwashing with water/air. In order to remove organic and inorganic matter that might form a coating on sand, it is necessary to drain the filter to rake them and to expose them to dryness once a fortnight. Then they should be immediately washed to get rid of fine dirt. Similarly, each filter should be superchlorinated for one hour. The top layer of sand (15 cm) may be washed in a Nicholds sand washer. Investigations are necessary under tropical conditions to find out the best working system from all points of view. (Baker-IVI)
W86-00399

WATER CHEMISTRY AND MATERIALS ECONOMY (WASSERCHEMIE UND STOFFWIRTSCHAFT),

Technische Univ., Dresden (German D.R.). Sektion Verabeitungs- und Verfahrenstechnik.
M. Schubert, and J. Kaeding.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 2, p 117-120, 1984. 1 Ref.

Descriptors: *Water chemistry, *Water quality, Drinking water, Water treatment, Economic aspects, Environmental effects, Energy, Industrial water, Irrigation water.

For solving of the most important problems concerning water quality economy, drinking water supply, industrial water and irrigation water without hazardous or otherwise detrimental substances the available findings and results of specialized research in water chemistry are needed. In the logical continuation of the development to the level necessary for practical application, the experts in the engineering disciplines have to be consulted. The design of the sequence of water treatment processes depends on the aims of the tasks set, and questions are increasingly being raised concerning the possibilities of saving and recovery of energy and raw materials. In the area of production, in the interest of environment protection one already endeavours to achieve a direct or indirect low-waste or non-waste process design. Finally, possibilities of materials and power economy are discussed using the examples of treatment of chemical industry wastewaters and municipal wastewaters. (Author's abstract)
W86-00402

MOLECULAR MASS DISTRIBUTION OF ORGANIC SUBSTANCES IN THE DRINKING WATER OF PRAGUE (MOLMASSEVERTEILUNG DER ORGANISCHEN STOFFE IM PRAGER TRINKWASSER),

Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Lehrstuhl fuer Wassertechnolgie und Umweltschutz.
P. Lischke, and J. Chudoba.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 2, p 121-129, 1984. 1 Fig, 4 Tab.

Descriptors: *Drinking water, *Organic matter, *Prague, *Czechoslovakia, Jizera, Vltava, Zelivka, Water quality, Gel chromatography, Chemical oxygen demand, Flocculation, Water treatment, Organic carbon.

The water supply of Prague (Czechoslovakia) is based upon three different water resources: artesian groundwater and infiltrate of the Jizera river, water of the Vltava and Zelivka rivers. The processing techniques are different; consequently for the purpose of increasing capacity one has to search for the suitable raw water quality as well as for the optimum treatment process. An essential parameter for this is the contents of organic substances whose mass distribution is investigated by gel chromatography with the aid of Sephadex G-10, G-25 and G-50. With respect to the total load of organic matter the Jizera shows the lowest values, in the Vltava the C.O.D. values are the highest, in the Zelivka the organic carbon shows the highest values. 80% of the organic substances in water have molar masses below 700. By flocculation 60-70% of the C.O.D.-Cr can be eliminated, the optimum removal of the high-molecular substances occurring at pH = 6 and with 50-60 g/cu m aluminium sulfate. (Author's abstract)
W86-00403

CAPACITY OF MACROPOROUS ADSORBER POLYMERS IN THE ELIMINATION OF ORGANIC MICROCONTAMINANTS (ZUM LEISTUNGSVERMOGEN MAKROPOROSER ADSORBERPOLYMERE BEI DER ELIMINATION ORGANISCHER MIKROVERUNREINIGUNGEN),

Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
H. J. Walther, J. Kaeding, and P. Fechner.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 2, p 173-181, 1984. 5 Fig, 4 Tab, 6 Ref.

Descriptors: *Organic compounds, *Adsorption, *Polymers, *Water treatment, Adsorbents, Filtration, Activated carbon, Desorption.

In laboratory experiments the adsorption of eleven different organic substances in water was individually tested in the range of concentration of 0.2-5.0 mg/l on EP 60 and EP 61 (styrene-divinylbenzene, non-polar) and EP 62 and Y 59 (acrylic-acid-ester-divinylbenzene, polar). In batch experiments the elimination at 1-2 g/l adsorber quantity was 35-80%, strongly dissociated anionic substances such as benzoic acid being adsorbed only to a low degree and weakly cationic and undissociated substances being adsorbed well. Within a homologous series, adsorption increases with the molar mass until the pore diameter became too small for the up-take of substances. Under dynamic conditions (filtration technology) an elimination of 90-100% can be expected. As a whole, the adsorption on activated carbon was better in all cases than the adsorption on the polymers. The desorption for the regeneration of the polymers is more difficult the better the substance contained is adsorbed. By repeated loading and regeneration only a slight influence on the adsorption and desorption of a substance was found. (Author's abstract)
W86-00409

DISINFECTION OF DRINKING WATER - A CRITICAL REVIEW (DIE DESINFEKTION VON TRINKWASSER - EIN KRITISCHER UBERBLICK),

Bremer Umweltinstitut fuer die Analyse und Bewertung von Schadstoffen (Germany, F.R.).
B. Stachel, B. Gabel, U. Lahl, and B. Zeschmar.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 5, p 499-519, 1984. 4 Fig, 10 Tab, 119 Ref.

Descriptors: *Disinfection, *Drinking water, *Reviews, Chlorination, Trihalomethanes, Chlorine dioxide, Halogenated hydrocarbons, Chloramine, Ozone, Ultraviolet radiation, Water treatment.

In drinking water chlorination about 90% of the chlorine shows an oxidizing effect, 10% results in halogenated reaction products, and ca. 1% results in trihalomethanes. When chlorine dioxide is applied, the trihalomethanes remain below the detection limit, but increasingly polar organic reaction products originate. Chloramine is rarely applied, mostly for storage reservoir waters. Little information about reaction products is available. With the application of ozone one obtains a wide spectrum

of reaction products; the aldehyde contents can be influenced by activated carbon. Especially critical is the formation of persistent epoxides, especially from pesticides. Ultraviolet irradiation is gaining in interest, and in many cases its biocidal effect is superior to that produced by chlorination and ozonation, except for the problem of re-germination in the water supply network. The costs of ultraviolet irradiation are much higher than those of the other techniques; chlorination costs only about one quarter as much as the other chemical disinfection techniques. (Author's abstract)
W86-00417

POTENTIOMETRIC FLUORIDE DETERMINATION IN DRINKING WATER (POTENTIOMETRISCHE FLUORIDBESTIMMUNG IN TRINKWASSER),
Bezirks-Hygieneinspektion und -Inst. Cottbus (German D.R.).
K. Seifert, and W. Klaue.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 4, p 377-382, 1984. 4 Tab, 5 Ref.

Descriptors: *Fluorides, *Drinking water, *Potentiometry, Water analysis, Interference.

The measurement is carried out after addition of perchloric acid up to a concentration of 0.45 M perchloric acid, and the results are compared with those obtained in 0.16 M sodium citrate as well as with a gas-chromatographic determination, and they show a good agreement. The detection limit is 0.002 mg/l F(-), the coefficient of variation is nearly 0.01 at 0.85 mg/l F-, independently of whether a direct measurement or a measurement with a standard addition is carried out. The measurement is disturbed by aluminium (III)- and iron(III)-ions. (Author's abstract)
W86-00539

DIURNAL THERMAL STRATIFICATION AND FLOC RISING IN CLARIFLOCCULATORS OF THE TROPICAL WATER WORKS,
Bhopal Univ. (India). School of Biological Science.
D. K. Belsare, and D. Y. Prasad.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 4, p 393-398, 1984. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Flocculation, *Tropical regions, *Thermal stratification, *Water treatment, *Floc rising, Filtration, Aeration, Supersaturation, Dissolved oxygen, Photosynthesis, Phytoplankton.

Water treatment facilities in tropical areas may have difficulties caused by floc rising; the flocs pass on to the rapid sand filters and reduce the filter run. Floc rising occurring during the day-hours (especially in the hot season) in the flocculators was investigated at four tropical water works. This phenomenon is caused by the great heating of the raw water during the daytime. Between 10.00 a.m. and 10.00 p.m., a temperature difference up to 3.7 K between the influent and the effluent of the flocculators occurs during a retention period of 3.5-5 h within the flocculators. Every temperature differences of only 1 K result in floc rising, reducing the filter run by four to seven hours. Oversaturation of the raw water with oxygen by the photosynthetic oxygen production constitutes an additional cause. The aeration of the water at the raw water intake point is recommended to prevent a thermal stratification during the day-hours and at the same time to remove the oxygen oversaturation. The phytoplankton population should also be kept at an optimum level to reduce floc rising. (Moore-IVI)
W86-00541

NITRATE IN DRINKING WATER - PROBLEMS OF HYGIENE AND TREATMENT (NITRAT IM TRINKWASSER - HYGIENISCHE UND AUFBEREITUNGSTECHNISCHE),
Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Wasserchemie und Chemische Balneologie.
J. Putzien.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 6, p 577-593, 1984. 12 Fig, 3 Tab, 14 Ref.

Descriptors: *Nitrates, *Drinking water, *Water treatment, Groundwater pollution, Methemoglobinemia, Carcinogens, Teratogens, Mutagens, Ion exchange, Reverse osmosis, Electrodialysis, Denitrification.

The increasing nitrate concentrations in the ground water and drinking water which are caused by intensified fertilizing lead to the risk of methemoglobinemia of babies and increase the cancerogenic, teratogenic and mutagenic risk for the total population. In the drinking water conditioning the nitrate concentration can be reduced by different techniques. By ion exchange first the SO4-ions and then the nitrate-ions are removed. The exchange is very favorable for HCO3(-) and the regeneration by means of carbon dioxide and CaCO3, for which a mass balance of substances is given. With 0.55 DM/cu m also the reverse osmosis in a mixture with raw water is practicable and also electrodialysis can be applied, whereas the biological techniques of the heterotrophic or autotrophic denitrification still include unsolved technological problems due to the necessity of an organic substrate or of H2. The special features of each of these techniques and the hygienic and also the corrosion-chemical consequences are indicated. (Author's abstract)
W86-00545

5G. Water Quality Control

ENVIRONMENTAL ASPECTS OF ARTIFICIAL AERATION AND OXYGENATION OF RESERVOIRS: A REVIEW OF THEORY, TECHNIQUES, AND EXPERIENCES,
Tetra Tech, Inc., Bellevue, WA.
R. A. Pastorok, M. W. Lorenzen, and T. C. Ginn.
Technical Report E-82-3, May 1982. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 277 p, 26 Fig, 21 Tab, 327 Ref, Append.

Descriptors: *Water quality control, *Aeration, *Reservoirs, *Lakes, *Water circulation, *Destratification, *Mixing, Hypolimnion, Reservoir releases, Outlets, Tailwater, Oxygenation, Pumps, Aquatic life, Algae, Phytoplankton, Biomass, Fish, Zooplankton, Eutrophication, Stratification, Thermal stratification.

This report includes (1) a literature review of aeration/circulation techniques for reservoirs, (2) a statistical analysis of alternative artificial circulation methods, (3) morphometric and water quality data for 107 reservoirs, and (4) an evaluation procedure for alternative management applications in reservoirs. Artifical destratification usually elevates dissolved oxygen levels in a lake by bringing anoxic bottom waters to the surface for aeration from the atmosphere. Oxygenation may precipitate phosphates and inhibit nutrient release from sediments, which may be counteracted by invertebrate activity. If pumps are undersized or destratification is untimely with respect to algal blooms, oxygen deficits can be aggravated. Mixing at the surface usually reduces algal biomass per unit area of lake surface, lowers the pH in the upper waters, replaces blue-green algae with green algae, increases the zooplankton and benthic macroinvertebrate populations, and produces short-term increases in fish growth and yield. Hypolimnetic aeration improves water quality without disrupting thermal stratification. Although hypolimmetic aeration has limited effect on algal blooms, the risk of adverse effects is lower. Oxygenation of downstream reaches can be accomplished by hypolimnetic aeration, localized mixing, aeration in the outlet works, and tailwaters aeration.
W86-00327

GROUNDWATER MANAGEMENT STRATEGY FOR MICHIGAN: DRAFT RESPONSE AND INCIDENT TRACKING PROCEDURES.
Michigan Dept. of Natural Resources, Lansing. Water Quality Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-116087. Report MI/DNR/GW-82/05, July 1982. Tasks 6 and 3. 13 p. 3 Fig. Contract/Grant No. P00558801.

Descriptors: *Groundwater, *Groundwater management, *Groundwater pollution, Water quality, Resource management, Water pollution control, Regulations, *Michigan.

Several management tools are needed to guide state response to incidents of groundwater pollution because of the large number of incidents at which state response actions may need to be performed. Two primary management tools for Michigan are described in this document. These management tools are: (1) General Response Procedures, guidance as to how and when state actions are initiated in response to incidents of groundwater pollution concern; and (2) Incident Tracking Procedures, and information management system to facilitate the recording, tracking and distribution of information on the status of each contamination incident. Draft Response and Incident Tracking procedures are presented and will be further refined as the project proceeds.
W86-00362

IMPACT OF THE SILVER CARP (HYPOPHTHALMICHTHYS MOLITRIX VAL.) ON THE ECOSYSTEM OF CARP PONDS,
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Dept. of Pond Management.
For primary bibliographic entry see Field 5B.
W86-00439

CHESAPEAKE BAY: SAVING A NATIONAL RESOURCE THROUGH MULTI-STATE COOPERATION,
Bureau of National Affairs, Inc., Washington, DC. Dept. of Environment, Safety and Health Services.
For primary bibliographic entry see Field 6E.
W86-00572

POINT SOURCE WATER QUALITY CONTROL IN VIRGINIA: CHOICES FOR THE CHESAPEAKE,
Chesapeake Bay Foundation, Inc., Richmond, VA.
J. M. Watson.
Virginia Journal of Natural Resources Law, Vol. 4, No. 2, p 263-300, 1985. 203 Ref.

Descriptors: *Water pollution control, *Water quality control, *Chesapeake Bay, *Virginia, Governmental interrelations, Wastewater treatment, Nutrients, Water quality standards.

Water quality degradation in the Chesapeake Bay, early judicial attempts to remedy water quality damage in Virginia, state legislative approaches to water quality protection, federal water quality legislation, Virginia's water quality control program and legal challenges to its implementation, and the Virginia Chesapeake Bay initiatives are reviewed, and recommendations are made that would help retard the deterioration of the Bay. Emphasis is placed on point sources of pollution. Two divergent policy trends are apparent: (1) the recognition by the Environmental Protection Agency (EPA) of the need for advanced wastewater treatment for nutrients and toxic substances, particularly in the James River and Hampton Roads areas, which implies technology forcing standards and limitations, and (2) the Virginia Supreme Court's limitation of the State Water Control Board exclusively to the enforcement of standards and limitations that can be met with existing technology. Furthermore, the State Water Control Board, after initial efforts in several areas, has largely abandoned addressing nutrient problems through the National Pollution Discharge Elimination System program. Recent cooperative efforts among jurisdictions surrounding the Bay, in response to the EPA Chesapeake Bay program study, make now a good time for renewed attempts to control pollution. The Virginia Chesapeake Bay initiatives may not be able to be meaningfully implemented, however, until the Virginia General Assembly moves to reverse the holding in the County Utilities case, which limits action to available technology, thus not allowing technology forcing. In addition, funding of programs should be increased for efforts to

clean up the Bay, and day-to-day activities of enforcement, maintenance, repair, personnel training, and continued research and application should be continued. (Rochester-IVI)
W86-00575

6. WATER RESOURCES PLANNING

6B. Evaluation Process

RIPARIAN AND STREAM ENHANCEMENT MANAGEMENT AND RESEARCH IN THE ROCKY MOUNTAINS,
Intermountain Forest and Range Experiment Station, Boise, ID.
W. S. Platts, and J. N. Rinne.
North American Journal of Fisheries Management, Vol. 5, No. 2A, p 115-125, Spring, 1985. 1 Fig, 1 Tab, 71 Ref.

Descriptors: *Riparian waters, *Rocky Mountains, *Stream enhancement, Management, Streams, Water management, Planning, Land use, Streambanks, Vegetation, Aquatic animals.

The most important research efforts conducted to date are reviewed and evaluated concerning their adequacy and effectiveness of future stream enhancement projects. The available research results also are stratified by components that comprise the aquatic habitat: riparian, water column, stream bank, channel, and biotic. The importance of riparian ecosystems was first addressed seriously in the late 1970's. Because riparian vegetation responds quickly to changes in management, in many cases restoration can be made to damaged riparian habitats with the time required depending on climatic conditions, soil fertility and surrounding land use. Reports are discussed which touch on the following areas of interest: importance of vegetation in riparian areas, fencing riparian areas, stream rehabilitation (with emphasis on water column, and channel characteristics), rehabilitating aquatic biota (threatened and endangered fish, nonthreatened fish, and macroinvertebrates), and proposals for sensible stream research and enhancement. Most watershed research has been oriented toward the production of specific products such as forage, meat, timber, and minerals. Such research has usually been aimed at evaluating the impacts of commodity production on other values such as fishing. Research aimed at mitigating or rehabilitating degraded aquatic environments needs special attention in the next decade. Emphasis should be placed on determining how to incorporate compatible grazing strategies into land management, conducting long term studies on stream enhancement structures to determine success, proper location, and adaptability to the different stream conditions, and conducting studies to better understand how enhancement projects affect fish communities and their environments. (Baker-IVI)
W86-00588

6D. Water Demand

WATER SUPPLY STUDY: SACO AND SOUTHERN MAINE RIVER BASINS.
Sverdrup and Parcel and Associates, Inc., Boston, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as ADA 120116. Corps of Engineers Water Supply Study, March 1982. 64 p. 16 Tab, 2 Maps, 14 Ref. Contract/Grant No. DACW33-80-C-0085.

Descriptors: *Water demand, *Water supply, *Water resources development, *Water scarcity, Water conservation, Groundwater availability, Groundwater, Maine, Planning.

Several very serious deficiencies of water supply have been identified in the southern Maine coastal area, specifically the seven communities of Kittery, Eliot, York, Wells, Kennebunk, Arundel and Kennebunkport. There are problems meeting both peak seasonal demand and peak daily demands. A short-term solution to these peak deficits can be achieved in most cases through the use of equalizing storage facilities, peak pricing and regulation measures. Long-term demand projected to the year 2030 can be met by combination of conservation and increased use of Saco River water. There is a danger of future contamination of the upper Saco River that is currently being examined by the states of Maine and New Hampshire.
W86-00371

ISSUES IN THE JAMES RIVER CORRIDOR,
Richmond Regional Planning District Commission, VA.
For primary bibliographic entry see Field 6G.
W85-00582

6E. Water Law and Institutions

MAJOR PROJECT IN THE AGE OF THE ENVIRONMENT: OUT OF CONTROVERSY, COMPLEXITY, AND CHALLENGE,
Corps of Engineers, Mobile, AL. Mobile District.
N. D. McClure, IV.
Environmental Geology and Water Science, Vol. 7, No. 1/2, p 15-24, 1985. 2 Tab, 17 Ref.

Descriptors: *Water resources development, *Tennessee-Tombigbee Waterway, *Environmental effects, *Legal aspects, Regulations, Planning, Waterways, Construction.

Throughout its development, the Tennessee-Tombigbee Waterway (Tenn-Tom) has experienced a turbulent existence. It has been subjected to considerable scrutiny from all three branches of the federal government. Central among these challenges was the litigation involving allegations under the National Environmental Policy Act. Environmental issues and controversies related to the Tenn-Tom included the following: hydrogeology; basin connection and water transfer; water quality; sedimentation and erosion; change of free flowing streams to impoundments; disposal of excavated material; loss of wildlife habitat; cultural resources; navigation impacts; and indirect impacts such as induced land use changes and alterations to the socioeconoic situation. (Baker-IVI)
W86-00333

EPA DEBATES SWITCH FROM THE CARROT TO THE STICK IN SEWAGE TREATMENT,
For primary bibliographic entry see Field 5D.
W86-00559

INDIAN ALLOTMENT WATER RIGHTS,
Colorado Univ. at Boulder. School of Law.
R. B. Collins.
Land and Water Law Review, Vol. 20, No. 2, p 421-457, 1985. 180 Ref.

Descriptors: *Indian rights, *Water rights, *Tribal lands, Native Americans, Legal aspects, Indian reservations, Federal jurisdiction, State jurisdiction.

Allotted tribal lands create troublesome questions for western water lawyers. In this article the author reviews the history of basic Indian reservation water rights created by the Supreme Court's landmark decision in Winters v. United States. The disposition of those rights when reservation lands are allotted are then explained. Finally, the difficult issues that arise when allotted lands pass from the federal trust, become subject to state law, and are transferred to non-Indians, are discussed. (Author's abstract)
W86-00560

FORFEITURE PROCEEDINGS IN WYOMING WATER LAW: THE LEGISLATURE REVIVES PRIVATE STANDING,
E. W. Harris.
Land and Water Law Review, Vol. 20, No. 2, p 459-474, 1985. 113 Ref.

Descriptors: *Wyoming, *Water rights, *Private standing, *Forfeiture, Prior appropriation, Beneficial use, Legal aspects, Standing.

Wyoming water law, like much of that in the United States, was based initially on a simple prior appropriation concept: those who put water to beneficial use first were entitled to its use. This provided security for investors and encouraged the most productive economic use, thus benefitting society in general. State administration improved this pioneer concept by adding an orderly way to keep track of dates of appropriation and to recognize challenges to others' water rights. Water rights that are forfeited return to state ownership, and can thus be appropriated by someone else. Prior to 1984, standing to bring forfeiture proceedings was gained merely by showing that the plaintiff was 'affected' within the meaning of the forfeiture statute. In 1984 the Wyoming Supreme Court in Cremer versus State Board of Control appeared to change the definition of standing. In the decision in Platte County Grazing Association versus State Board of Control, the Court made it clear that the junior appropriator had to show injury to have standing to attack a senior's rights. This decision represented a major change in Wyoming water law that did not conform to precedent. The Wyoming Legislature in 1985 amended the forfeiture statute to grant standing to make it clear that 'affected' in the law meant either benefitted or injured, not just the latter, as the Court had held. (Rochester-IVI)
W86-00561

SIXTH CIRCUIT'S UNSETTLING INTERPRETATION OF THE CORPS OF ENGINEERS' WETLAND DEFINITION. UNITED STATES V. RIVERSIDE BAYVIEW HOMES, INC., 729 F. 2D 391 (6TH CIR. 1984), CERT. GRANTED, 53 U.S.L.W. 3597 (U.S. FEB. 19, 1985) (NO. 84-701),
K. Lamere.
Land and Water Law Review, Vol. 20, No. 2, p 475-484, 1985. 90 Ref.

Descriptors: *Wetlands, *Judicial decisions, *Riverside Bayview Homes, *Michigan, Clean Water Act, Flooding, Fill permits, Navigable waters.

Riverside Bayview Homes, Inc., of Michigan (USA) was enjoined by district court from filling an 80-acre wetland north of Detroit as a result of an enforcement proceeding filed by the Department of the Army, Corps of Engineers (Corps) in compliance with the Clean Water Act (CWA). On a second appeal, after once sending the case back to district court, the Sixth Circuit Court reversed the holding of the district court, interpreting the CWA definition of wetlands to require 'frequent flooding by water flowing from navigable waters' as defined in the Act. The court held that the definition did not cover 'inland lowlying areas such as the one in question here that sometimes become saturated with water.' The Sixth Circuit finding conflicts with those of other circuit courts, and it appears to ignore specific, clear language in the CWA, which has been steadily expanded since its passing to define wetlands more broadly. The court established a jurisdictional limitation (navigable waters) that does not appear in CWA itself, it ignored the words 'or saturated' (regardless of mechanism of inundation) that appear in the Act, it ignored the administrative record previously established in wetland cases, and it cited the taking issue involved in Kaiser Aetna versus United States, which was unjustified. The Sixth Circuit's ruling in Riverside raises questions about the Corp's wetlands definition and regulatory permitting process. The ruling contradicts both accepted congressional intent of the CWA and wetlands case law. The Supreme Court has agreed to review this decision. (Rochester-IVI)
W86-00562

VIOLATION OF NEPA ENVIRONMENTAL IMPACT STATEMENT REQUIREMENT EXCUSED BY SUBSEQUENT AGENCY CONSIDERATION OF ALTERNATIVES. FRIENDS OF THE RIVER V. FEDERAL ENERGY REGULATORY COMMISSION, 720 F.2D 93 (D.C. CIR. 1983),

E. Merila.
Land and Water Law Review, Vol. 20, No. 2, p 486-492, 1985. 56 Ref.

Descriptors: *Environmental Impact Statement, *Hydroelectric power, Calaveras County, California, Dams, Alternative planning, National Environmental Policy Act.

In the case of Friends of the River (FoR) versus Federal Energy Regulatory Commission (FERC) the United States Court of Appeals, District of Columbia Circuit, held that FERC did not violate National Environmental Policy Act (NEPA) requirements, but that a remand of the case was unnecessary because FERC had discussed the subject at issue in its response to a previous complaint. FoR originally petitioned FERC for a rehearing on the Environmental Impact Statement (EIS) prepared in support of building a dam in Calaveras County, California (USA), because the final EIS contained only two sentences on the alternative of purchasing power from other utilities, a procedure suggested by FoR in their comments on the draft EIS. In denying the request for a rehearing, FERC addressed the purchase of power in its response, but did not reopen the EIS procedure. FoR contended that FERC 'neglected its duties' under NEPA by failing to consider and present the alternative in the EIS itself. The court did not agree with the FoR contention, even though its holding clearly conflicts with NEPA's procedural commands and the policies underlying these procedures. The three cases cited by the court, Scenic Hudson Preservation Conference versus Federal Power Commission, Swinomish Tribal Community versus FERC, and Warm Springs Dam versus Gribble, did not really support the court's holding. The result contrasts with National Wildlife Federation versus Andrus, where the court held that the reasons for accepting or rejecting alternatives must be set out in the EIS, and not in papers filed with the court. The court in this case had concluded that the violations required a remand, but did not require it because the FERC submission had remedied the defects in the final EIS. This outcome is contrary to the intent of Congress in adopting NEPA, and is not supported by precedent. It indicates that an EIS can be a pro forma rationalization, rather than an important tool in an agency's decision-making process. (Rochester-IVI)
W86-00563

WHEN WATER QUANTITY REGULATION IS NOT WATER QUANTITY REGULATION. RIVERSIDE V. ANDREWS, 568 F. SUPP. 583 (D. COLO. 1983),
T. Vincelette.
Land and Water Law Review, Vol. 20, No. 2, p 523-533, 1985. 79 Ref.

Descriptors: *Riverside Irrigation District, *Colorado, *Water quality control, *Regulations, Fill permits, Dam construction, State jurisdiction, Federal jurisdiction, Environmental effects.

Riverside Irrigation District (Colorado) brought suit against the Army Corps of Engineers (Corps), claiming that the Corps lacked authority to deny a request for a dredge and fill permit for their dam project because they were entitled to an automatic nation-wide permit for their dredge and fill activities. Their complaint (Riverside versus Andrews) was denied in Colorado district court. The Corps contended that denial of the permit represented proper exercise of its authority to regulate water quantity, which would be affected by the project once it began operation. The Corps argued that it was exercising federal police powers by considering the project's environmental effects, which in this case included destruction of habitat of the whooping crane (an endangered species), and that the permit was denied on these grounds. The district court held that the Corp's action was correct. Riverside had argued that the Corp's authority was limited to the construction phase of the project only, and did not extend to the operational phase, in which minimal flow requirements, if there were to be any, would be determined by state water law, rather than federal laws. The court noted in Riverside versus Andrews: 'although the defendant's actions may have a substantial effect on state water rights, such is the case with many federal laws which particularly pre-empt state water laws.' Riverside's appeal of the district court decision is pending in Tenth Circuit Court. (Rochester-IVI)
W86-00564

EXERCISE OF FEDERAL JURISDICTION IN RESERVED WATER RIGHTS LITIGATION. UNITED STATES V. ADAIR, 723 F.2D 1394 (9TH CIR. 1983), CERT, DENIED SUB. NOM. OREGON V. UNITED STATES, 104 S. CT. 3536 (1984),
M. Reynolds.
Land and Water Law Review, Vol. 20, No. 2, p 511-521, 1985. 75 Ref.

Descriptors: *Federal jurisdiction, *Litigation, *Water rights, Reservation doctrine, Indian reservations.

When a suit originally filed by the United States in Oregon district court to obtain a declaration of water rights within the area once part comprising the Klamath Indian Reservation was adjudicated in favor of the federal government, the state appealed in Ninth Circuit Court on the grounds that the district court should have dismissed the suit. The Court of Appeals held that when a district court has proceeded to determine the nature and priority of water rights that are governed by federal law in a case involving Indian litigants, its decision should not be reversed. The Ninth Circuit court determined in this appeals case (United States versus Adair) that all three exceptions applying in the Arizona versus San Carlos Apache Tribe case also applied here. The court rejected the state's argument that the exercise of jurisdiction would be contrary to the policy of the McCarran Amendment. Although, at first glance, it appears that the Ninth Circuit correctly applied the San Carlos exceptions to the facts of Adair, the facts do not fit the exceptions ('express agreement to stay', 'adjudication of Indian rights', and 'delay in the motion to dismiss'). The court's dilemma in Adair was that, by the time the appeal was filed, the district court had taken 8 years to complete its work, and holding for the plaintiff would have meant starting over. In Adair, the district court should clearly have abstained under the Colorado River abstention doctrine, but did not. Not only did United States versus Adair undermine the Colorado River doctrine, but it violated the Supreme Court's guidelines in San Carlos. To avoid the dilemma presented by this case in the future water rights attorneys should appeal the denial of dismissal motion immediately, not after the completion of the district court's work. (Rochester-IVI)
W86-00565

COASTAL ZONE MANAGEMENT ACT: A PROTECTIVE MANDATE,
Natural Resources Defense Council, Inc., Washington, DC.
S. Chasis.
Natural Resources Journal, Vol. 25, No. 1, p 21-30, January, 1985. 51 Ref.

Descriptors: *Coastal Zone Management Act, *Legislation, Coastal areas, Standards, State jurisdiction, Federal jurisdiction, Resources management.

The rationale of the Coastal Zone Management Act (CZMA), its provisions, it problems of statutory structure and implementation, and the continued importance of its purpose are discussed. Review of the original debates at the time the Act was passed make clear the Congress recognized the deteriorating condition of coastal resources and the inability of state and local governments alone to effectively deal with the situation. A list of national coastal objectives was drawn up that included protection of natural systems, minimization of loss of life and property due to coastal development, and coordination and simplification of government procedures, among seven original items. Later, waterfront economic development and management of living marine resources were added, but attempts have been made to deny funding for this already broad responsibility on the grounds that the federal role is over, and that the states could and would assume full responsiblity for funding the programs. Thirty states (including those bordering the Great Lakes) and five territories are eligible for federal funds under the CZMA. Responsibility for administering the Act is assigned to the Secretary of Commerce, who designated the National Oceanic and Atmospheric Administration (NOAA) as the agency to manage the program. Within NOAA, the responsibility resides in the Office of Ocean and Coastal Resources Management. The statute is very broad, and participation is voluntary. A number of states have no coastal plans, and in others the coastal programs are ineffective. Federal implementation has been weak in the areas of standards for program approval, standards for review of state performance, and a lack of clarity about program benefits to the states. The needs existing at the time the CMZA was originally proposed still exist. State and local programs should be improved as a protection against the possible loss of the CMZA program, but because of the great national importance of the coasts, the program should not be terminated. (Rochester-IVI)
W86-00566

CZM FROM THE STATE PERSPECTIVE: THE NEW JERSEY EXPERIENCE,
Kinsey (David N.) Associates, Princeton, NJ.
D. N. Kinsey.
Natural Resources Journal, Vol. 25, No. 1, p 73-102, January, 1985. 108 Ref.

Descriptors: *Coastal Zone Management Act, *New Jersey, Resources management, Coastal areas, Land use, Nuclear powerplants, Urban areas.

The experience of the State of New Jersey (USA) with implementation of its responsibilities under the federal Coastal Zone Management Act (CZMA) is reviewed, including: incentives of the CZMA for coastal states, contents of the state's coastal management program, the Coastal Area Facility Review Act (CAFRA, New Jersey's main coastal zone management legislation), criteria for evaluating state coastal management programs, and case examples of the functioning of New Jersey's management effort. Among major issues that were dealt with under CAFRA are the growth of the Atlantic City region in the casino era, historic preservation and hotel-casino design, nuclear energy and coastal land use, and beach area transportation regulation and improvement. The net result of the New Jersey experience under CZMA is a firmly established, detailed, and working framework for coastal decision making by state agencies, local governments, and the private sector on a wide variety of uses of coastal resources. In light of the New Jersey experience the incentive of 'federal consistency' has proven only a negative control which could block a federal action, but could not require a federal agency to act affirmatively in a manner desired by a coastal state. A wide variety of regional and national interests in the coastal zone are now being considered more explicitly and with greater results than before enactment of the federal Coastal Zone Management Act. No constituency exists for coastal zone management by government per se, because each constituency has its own opinion about the best course and there is a general anti-regulation sentiment and desire for local control. The technical assistance provided by the federal coastal bureaucracy is extremely important and should be greatly expanded; the financial assistance to and through states to local governments under the CZMA is crucial. (Rochester-IVI)
W86-00567

CZM IN CALIFORNIA, OREGON, AND WASHINGTON,
Oregon Univ., Eugene.
R. G. Hildreth, and R. W. Johnson.
Natural Resources Journal, Vol. 25, No. 1, p 103-165, January, 1985. 346 Ref.

Descriptors: *Coastal Zone Management, *California, *Oregon, *Washington, Public participation, Planning, Governmental interrelations, Resources management, Enforcement.

The coastal zone management (CZM) activities of the Bay Conservation and Development Commission (San Francisco), and the state programs of California, Oregon and Washington are discussed in terms of public participation, state and local government relationships, enforcement of program requirements, federal consistency with approved state programs, and development in hazardous coastal areas. Two of the three states which delegated substantial coastal planning responsibilities to local governments experienced significant delays in completing the process. The experience suggests that many local governments cannot or will not meet the technical requirements of comprehensive coastal planning, even with significant federal and state financial support. Inadequate enforcement of program requirements has been the most common criticism of CZM in all three states; reduction of the programs' comprehensiveness, both in terms of issues addressed and geography, is one possible solution to the enforcement problems. A central element of all West Coast programs has been the policy that development on shorelines and in tidal and submerged areas should not be allowed unless they are 'water dependent.' Experience has shown that the water-dependency concept describes a priority rather than absolute rule. Successful implementation of the water-dependency concept requires a strong monitoring and enforcement effort above the local government level. The significant effect that programs have had in improving coastal zone management in the three states over the last decade raises legitimate expectations for their future success. Monitoring problems are unlikely to be solved by any strikingly new institutional measures. (Rochester-IVI)
W86-00568

EXISTING INSTITUTIONAL ARRANGEMENTS AND IMPLICATIONS FOR MANAGEMENT OF TOKYO BAY,

Yokohama City Univ. (Japan).
K. Sumi, and K. Hanayama.
Natural Resources Journal, Vol. 25, No. 1, p 167-193, January, 1985. 3 Fig, 3 Tab, 68 Ref.

Descriptors: *Tokyo Bay, *Japan, *Resources management, Governmental interrelations, Institutional constraints, Water quality control, Bays, Harbors, Marine environment, Ports, Fisheries, Land reclamation.

Tokyo Bay has been central to Japan's economy for a long time; in the middle of the 18th Century the population of Tokyo was 1.3 million. The area surrounding Tokyo Bay produced 22% of Japan's total industrial output in 1980. Although the central government is located in Tokyo, most of the important decisions concerning the ecosystem of the bay are made by local governments, which operate at two levels: prefecture and community. The system of managing the marine environment and resources of Tokyo Bay is characterized by a complex network of ad hoc measures taken by central and local governments with respect to different uses, including land reclamation, fisheries, construction of port facilities and industrial plants, maintenance and management of port facilities, prevention of marine pollution, and control of total pollutant load. The national government has taken some action to prevent or reduce deterioration of water quality and to protect the marine environment. The Environment Agency has been ineffective; it has limitations upon its administrative activities and authority, and other government agencies have limited its powers. Local governments set their own 'quality standards' or 'emission standards', which in many cases are stricter than those set by the central government. Enforcement typically takes the form of guidance, with punishment being used as a last resort. Generally, Japanese environmental policies have concentrated on pollution abatement, with little attention given to maintenance or enhancement of environmental quality ('amenities'). Tokyo Metropolis, Kanagawa Prefecture, Yokohama City, and Chiba Prefecture have independently developed and regulated their portions of the bay area. Public participation in decisions regarding use of Tokyo Bay has been limited in the past, particularly at the stage of issue formulation. There is a lack of integration and comprehensiveness in the management of the Tokyo Bay marine environment and resources. Establishment of a single, comprehensive agency probably is not the solution at present. An inter-prefectural forum to coordinate government activities is more practical. (Rochester-IVI)
W86-00569

ENVIRONMENTAL MANAGEMENT OF THE MALACCA/SINGAPORE STRAITS: LEGAL AND INSTITUTIONAL ISSUES,

Resource Systems Inst., Honolulu, HI.
M. J. Valencia, and A. B. Jaafar.
Natural Resources Journal, Vol. 25, No. 1, p 195-232, January, 1985. 3 Fig, 3 Tab, 146 Ref.

Descriptors: *Malacca/Singapore Straits, *Legal aspects, *Institutional constraints, *Environmental policy, Singapore, Malaysia, Indonesia, International law, Law of the sea, Water pollution control, Navigation.

The Malacca/Singapore straits, an area of high ship traffic volume, petroleum development, and trading, involves three national governments: Singapore, Malaysia, and Indonesia, each of which has its own priorities and limitations in dealing with management of the environment. The involved states have not harmonized their respective environmental policies and regulations, nor have any of them introduced the necessary legislation required by the Convention on Law of the Sea. Contingency plans for dealing with marine pollution due to accidents exist at the national level, under the aegis of the Association of Southeast Asian Nations, and in the form of the Malacca-Singapore traffic separation scheme. Specific legal issues that may arise in this region include: spatial interference with transit passage, innocent passage versus transit passage, extension of traffic lanes, duties of port states, traffic management, prohibited zones for tanker operation, tanker safety standards (special design and equipment requirements), different standards for vessels that frequently navigate the Strait versus those that only do so occasionally, imposition of charges, increased liability and compensation requirements, and required contingency plans. A review of the environmental laws and updating of rules and regulations of the three states to implement the relevant provisions of the Law of the Sea Convention would provide the necessary stimulus for harmonizing of laws. Another approach would be to harmonize practices and reconcile pollution control regulations only with respect to major pollutants. Other alternatives include ratification or accession to major international conventions of environmental relevance, development of a joint contingency plan for the Malacca Strait, and establishment of a compensation fund. Possible bases for allocation of contingency fund contributions are risk, geography, economic position, and benefits derived from the Straits. A joint management authority is the most idealistic solution and is not likely at present. (Rochester-IVI)
W86-00570

ENVIRONMENTAL MANAGEMENT IN A NORTH SEA COASTAL ZONE: LAW, INSTITUTIONS AND POLICY,

Durham Univ. (England).
L. Guruswamy.
Natural Resources Journal, Vol. 25, No. 1, p 233-242, January, 1985. 33 Ref.

Descriptors: *North Sea, *England, *Coastal Zone Management, *Institutional constraints, *Legal aspects, *Environmental policy, Resources management, International law, Water pollution control, Alternative planning.

A project is described that will attempt to formulate an integrated environmental and resource strategy for the North Sea based on the World Conservation Strategy by analysis of the case of the coastal zone of the County Cleveland in the United Kingdom. The site is a formerly diverse marine habitat now 'reclaimed' for industrial development, agriculture, and utilities. The proposed study will be conducted in two phases. First, applicable law will be researched, whether it be United Kingdom, European, or international law, and the degree to which the laws are fragmented or integrated will be determined. The law, together with the institutions and policies relevant to pollution control and resource conservation, then will by analyzed, clarified, and restated. In the second stage of the project an attempt will be made to apply the strategy in a practical way to achieve given objectives. In the first stage, uses natural resources in County Cleveland will be determined, the extent and nature of fragmentation or integration among pollution control, town and country planning, and conservation of species and habitat will be examined, and certain aspects of the European Parliament's relationship to the problems under consideration will be discussed. Conflicts of objectives within individual agencies, eg, water authorities, will be examined. In the operational phase of the project, an interdisciplinary approach will be taken to topics such as the following: an assessment of policy criteria and priorities in selecting use objectives for natural resources, a determination of sources of relevant pollution and wastes, consideration of alternative production processes, and an investigation of the feasibility of recycling some pollutants. (Rochester-IVI)
W86-00571

CHESAPEAKE BAY: SAVING A NATIONAL RESOURCE THROUGH MULTI-STATE COOPERATION,

Bureau of National Affairs, Inc., Washington, DC. Dept. of Environment, Safety and Health Services.
M. A. Hutter.
Virginia Journal of Natural Resources Law, Vol. 4, No. 2, p 185-207, 1985. 167 Ref.

Descriptors: *Chesapeake Bay, *Resources management, Governmental interrelations, Water pollution control, Environmental policy, Aquatic plants, Bays, Water pollution sources.

The value of the Chesapeake Bay as a natural resource, its decline as the result of pollution and other problems, and federal and state efforts to restore the Bay, from the December 1983 Chesapeake Bay Conference to the present, are reviewed. The Chesapeake Bay has more than 2,500 sq mi of surface area and about 8,000 miles of shoreline; it supports extensive recreation, port, and industrial activities. A 5-yr Environmental Protection Agency (EPA) study of the Bay's deterioration focused on three problems: loss of submerged aquatic vegetation, increases in concentrations of toxic chemicals, and nutrient enrichment. Four major phenomena were identified in 1982 and 1983 as contributing to the Bay's decline: population growth, increased urbanization, intensified agricultural activity, and wetlands loss. The Chesapeake Bay agreement of 1983, involving state Governors, the Mayor of Washington, District of Columbia (DC), and the EPA Regional Administrator, mandated twice yearly review of progress of Bay programs and annual reports on progress in implementation. Federal initiatives have been taken through EPA under the Clean Water Act. Other departments of the federal government have entered into joint resolutions with EPA agreeing to protect and enhance the condition of the Bay. In addition, state initiatives by Maryland, Virginia, Pennsylvania, the District of Columbia, and cooperative agreements, such as the Chesapeake Bay Commission, address specific problems created by each region's particular effect on the Bay. The key to the Chesapeake Bay Program's success so far has been cooperation and coordination among the federal and state agencies. It could take years, if not decades, however, for major programs established over the past year to become effective. The project is long-term and ongoing; reassessment of Bay programs in light of preliminary results will be necessary to keep restoration efforts oriented toward established goals. (Rochester-IVI)
W86-00572

PROBLEM OF PEOPLE: CRITICAL AREAS AND FLOATING ZONES IN THE CHESAPEAKE,

Briscoe, Kenney, Kaminetz and Lacer, Lexington Park, MD.
J. A. Kenney, III.
Virginia Journal of Natural Resources Law, Vol. 4, No. 2, p 209-218, 1985. 38 Ref.

Descriptors: *Chesapeake Bay, *Land use, *Floating zones, *Critical areas, Maryland, Zoning, Wildlife, Habitats, Recreation, Resources development.

Maryland's Chesapeake Bay Critical Area Act authorizes local jurisdictions to develop and implement programs to control the use and development of sensitive shoreline areas, designated by the act as 'Critical Areas.' The traditional approach to zoning involves a constant war for land use flexibility. The 'floating zone' concept was developed to permit certain land uses in accordance with an overall development plan for a designated area of land, without requiring a legislative determination of 'change or mistake' at the time of a comprehensive rezoning. A floating zone is a specialized use district created by ordinance that 'floats' over an entire jurisdiction until it attaches to a specific property upon the petition of the property owner. A site plan, which typically includes restrictions on maximum building area, minimum green area, and, in some cases, requires off-site improvements, must be approved by the local governing body. Plan approval can be revoked if the plan's provisions, including restrictions, are not complied with, or if there is no meaningful development within a reasonable period of time. In one case, a 200-acre development on the Patuxent River was approved under a floating zone. The project included a central marina, habitat preservation areas, community beach areas with restricted access areas, and central sewage; the density was increased from 1.0 units per acre to 2.83 units per acre as a result of rezoning. Numerous conditions were imposed, covering such areas as street design, parking, sediment and stormwater control, and limitations on pleasure boat mooring and use. The cost of development in this instance were borne by the private sector, and the costs of maintaining wildlife habitats were borne by the people with access to them. The floating zone and planned unit development concept can be an effect means to meet increasing development pressure in a creative, positive way. (Rochester-IVI)
W86-00573

INTERAGENCY DISPUTES OVER DRY FIELDS OR CLEAN WATER: A CASE STUDY OF THE CONFLICT BETWEEN AGRICULTURAL DRAINAGE PROGRAMS AND THE CHESAPEAKE BAY CLEANUP,
Arnold and Porter, Washington, DC.
For primary bibliographic entry see Field 6G.
W86-00574

POINT SOURCE WATER QUALITY CONTROL IN VIRGINIA: CHOICES FOR THE CHESAPEAKE,
Chesapeake Bay Foundation, Inc., Richmond, VA.
For primary bibliographic entry see Field 5G.
W86-00575

MAJOR ENVIRONMENTAL STATUTES AFFECTING THE JAMES RIVER,
Thomas and Fiske, Richmond, VA.
T. G. Hayes.
Virginia Journal of Science, Vol. 36, No. 1, p 37-44, Spring, 1985.

Descriptors: *Legislation, *James River, *Virginia, *Environmental effects, Policy, Regulations, Water pollution control.

The most important of the numerous federal and state laws enacted that directly or indirectly control the impacts of human activity on our waterways are reviewed and, in some cases, related to the James River. Laws discussed include the National Environment Policy Act of 1969, the Clean Water Act, the State Water Control Law (Virginia), the Rivers and Harbors Appropriation Act of 1899, Marine Resources Commission Permits, Resource Conervation and Recovery Act, State Solid Waste Management, Toxic Substances Control Act, Federal Environmental Pesticide Control Act, Ports and Waterways Safety Act, Atomic Energy Act, and the Comprehensive Environmental Response, Compensation and Liability Act of 1980. (Baker-IVI)
W86-00586

6G. Ecologic Impact Of Water Development

ASSESSMENT OF ENVIRONMENTAL CONSIDERATIONS IN THE DESIGN AND CONSTRUCTION OF WATERWAY PROJECTS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
F. D. Shields, and M. R. Palermo.
Technical Report E-82-8, September 1982. Final Report. 214 p, 71 Fig, 5 Tab, 156 Ref, Append.

Descriptors: *Environmental effects, *Waterways, *Construction, *Channel improvement, *Flood control, *Water quality, *Aquatic habitats, Levees, Dikes, Navigation, Bank protection, Protection, Stream stabilization, Stream banks, Transportation, Aquatic animals, Meanders, Habitats, Species diversity, Vegetation, Riparian vegetation, Land use, Aesthetics, Recreation, Wolf River.

Factors and constraints in design and construction of waterways projects affecting environmental quality are identified. Included are channel modifications for flood control and navigation, dikes, streambank protection, and levees. Adverse environmental impacts of flood control channel modification include a variable degree of loss of valuable habitats and habitat diversity, channel instability, reduction of aesthetic value, water quality degradation, and undesirable hydrologic changes. Methods to reduce adverse impacts are stream restoration, artificial instream structures, modified channel cross sections, and management of cutoff meanders. Navigation channel modifications produce losses in backwater habitat. Dike construction reduces water surface area and habitat diversity due to sediment accretion in the dike field. Notches or gaps in the dikes can slow the rate of sediment accretion. Bank protection causes loss of riparian vegetation and reduces the rate of channel migration. Some bank protection devices are vegetation and combinations of structure and vegetation. Levees create drier conditions on the landside of the levee and resulting land use changes. Vegetation on levees can be managed to preserve or improve wildlife habitats, aesthetics, and recreational features.
W86-00315

BENTHIC MACROINVERTEBRATES OF SELECTED AQUATIC HABITATS OF THE LOWER MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W86-00324

INSTRUCTION REPORT ON FRESHWATER MUSSELS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
For primary bibliographic entry see Field 2H.
W86-00325

USER'S MANUAL FOR THE EVALUATION AND SENSITIVITY ANALYSIS PROGRAM (ESAP),
Colorado Univ. at Boulder. Center for Research on Judgment and Policy.
J. Mumpower, and L. Bollacker.
Technical Report E-81-4, March 1981. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 279 p, 131 Fig, 3 Tab, 4 Append.

Descriptors: *Planning, *Environmental policy, *Water resources development, *Water management, *Sensitivity analysis, *Evaluation, Environmental effects Alternative planning.

The Evaluation and Sensitivity Analysis Program (ESAP) is an environmental planning technique for the evaluation of alternative water resource management plans. ESAP is based on a weighting-scaling approach to impact assessment and alternative evaluation. The evaluation of the desirability or acceptability of an alternative is based on a systematic combination of information about the impacts on the natural and cultural resources and information about the importance (weight) and preferred levels of such resources. Information for a number of individuals or groups is used to determine how sensitive their evaluations are to differences in judgments about the importance and preferred levels of resources or to uncertainty in projections of resource impacts. The analysis performed by ESAP provides the user with to basic types of information: (a) an evaluation of the alternatives for each individual or group considered and (b) an analysis of how the individuals or groups differ in their evaluation of alternatives. The analysis requires the user to provide a hierarchial description of the evaluation problem, which includes the variables or resources affected by the alternatives, projected levels of the variables or resources for each of the alternatives, and information about the weights or importance values and the variables for each of the groups under consideration. If the user wishes to examine the effects of uncertainty on evaluation, data describing uncertainty must also be input into the program. (Author)
W86-00328

REPORT OF FRESHWATER MOLLUSKS WORKSHOP, MAY 19-20, 1981.
Army Engineer Waterways Experiment Station, Vicksburg, MS.
Vicksburg, MS. Final Report, May 1982. Andrew C. Miller, compiler. 192 p.

Descriptors: *Environmental effects, *Rivers, *Mollusks, *Aquatic habitats, *Shellfish, Taxonomy, Endangered species, Higgin's eye mussel, Mussels, Aquatic animals, Sampling, Habitats, Lampsilis higginsi, Mississippi River.

A workshop on freshwater mollusks addressed the following subjects: (1) taxonomy and ecology of freshwater mussels, (2) appropriate sampling methodologies for mollusks, (3) methods to create habitat and/or relocate mollusks, (4) information available from commercial shell harvesters and (5) present and past concerns about endangered species. Although much of the data concerned the Upper Mississippi River and the Tennessee and Alabama river systems, the information can be applied to all freshwater mollusks regardless of location. The Endangered Species Act and program were described. Applying the taxonomic and ecological principles of immature biomes (as found in northern North America) to mature biomes (as found in the southeastern U.S.) are shown. Museums are a valuable resource in identification of mollusks; 25 museums are listed for reference. Of sampling techniques available, diving is best for deep water sampling, and hand-picking is best for shallow water. Brailing is effective for cursory surveys in large rivers. Mechanical dredges should be avoided. Other mollusk studies described are the distribution of Mobile Basin unionid mollusks, the Cumberlandian mollusk conservation program, relocation of an endangered species (Higgin's eye pearly mussel), the role of the U.S. Army Engineers in mollusk studies, and commercial aspects of mollusks.
W86-00329

OVERVIEW OF THE TENNESSEE-TOMBIGBEE WATERWAY,
Corps of Engineers, Mobile, AL. Mobile District.
For primary bibliographic entry see Field 8A.
W86-00332

MAJOR PROJECT IN THE AGE OF THE ENVIRONMENT: OUT OF CONTROVERSY, COMPLEXITY, AND CHALLENGE,
Corps of Engineers, Mobile, AL. Mobile District.
For primary bibliographic entry see Field 6E.

W86-00333

HYDROLOGY, HYDRAULIC, AND SEDIMENT CONSIDERATIONS OF THE TENNESSEE-TOMBIGBEE WATERWAY,

Corps of Engineers, Mobile, AL. Mobile District.
K. D. Underwood, and F. D. Imsand.
Environmental Geology and Water Science, Vol. 7, No. 1/2, p 69-90, 1985. 14 Fig, 10 Tab, 53 Ref.

Descriptors: *Tennessee-Tombigbee Waterway, *Construction, *Sedimentation, *Hydrology, Engineering, Water resources development, Hydraulic engineering, Design criteria, Monitoring.

The hydrology and hydraulic aspects of the Tennessee-Tombigbee Waterway system are described along with the hydraulic design of the hydraulic features, followed by a discussion of sedimentation characteristics of the waterway. A brief discussion is offered of the monitoring programs for the hydrological and sedimentological aspects of the project. Ten locks and dams were constructed that form lakes with a total water surface area of over 42,400 acres. The overall length of the waterway is 234 miles and required the excavation and disposal of over 307 million cu yd of material. Specific topics considered include climate, hydrology, sections of the waterway (river sections, canal section, and divide section), design and construction of the navigation channels, locks and dams and spillways, sedimentation, and project monitoring (river stage and stream gauging, and rainfall stations). (Baker-IVI)
W86-00336

CREATIVE SPOIL: DESIGN CONCEPTS, CONSTRUCTION TECHNIQUES, AND DISPOSAL OF EXCAVATED MATERIALS,

Louisiana State Univ., Baton Rouge. School of Environmental Design.
For primary bibliographic entry see Field 8A.
W86-00337

SUMMARY OF ENVIRONMENTAL ISSUES AND FINDINGS: TENNESSEE-TOMBIGBEE WATERWAY,

Corps of Engineers, Mobile, AL. Mobile District.
N. D. McClure, IV.
Environmental Geology and Water Science, Vol. 7, No. 1/2, p 109-124, 1985. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Tennessee-Tombigbee Waterway, *Construction, *Environmental effects, Decision making, Planning, Water resources development.

The enactment of the National Environmental Policy Act (NEPA) had a substantial influence on the manner in which the Tennessee-Tombigbee Waterway (Tenn-Tom) was constructed. The interdisciplinary approach including a board of outside consultants functioning as environmental advisors, played a valuable role toward meeting the objectives of minimizing adverse impacts and maximizing the positive environmental aspects. Impacts of the Tenn-Tom addressed include aquifer drawdown, waterlogging, water quality, interbasin transfer, mixing of species, endangered species, erosion, sedimentation, and loss of wildlife habitat. The findings are discussed, and the identified impacts placed into perspective. While implementation of the Tenn-Tom waterway involved losses and resource tradeoffs, measures have been incorporated into the project to mitigate for significant resource losses. The evaluation, planning, and design process for the Tenn-Tom can serve as model approach for compliance with NEPA and other environmental statutes. (Baker-IVI)
W86-00338

AQUATIC HABITAT STUDIES ON THE LOWER MISSISSIPPI RIVER, RIVER MILE 48-530: REPORT 2, AQUATIC HABITAT MAPPING,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
S. P. Cobb, and J. R. Clark.
Miscellaneous Paper E-80-1, U.S. Army Environmental and Water Quality Operational Studies, March 1981. 24 p, 4 Fig, 1 Tab, 3 Plates.

Descriptors: *Aquatic habitats, *Aquatic environment, *Aquatic life, Mapping, Impact, *Flow rates, *Lower Mississippi River, Channels, Banks, Sandbars, Dike fields, Floodplains, Borrow pits, Maps.

To provide data for design of field studies to determine the impacts and ecological value of the man-made habitats formed by dike and revetment structures in the Lower Mississippi River, the aquatic habitas of a 50-mile reach of the river (mile 480-530 Above Head of Passes, AHP) was quantitatively mapped to determine spatial relationships among and within habitat types as a function of river and discharge. Twelve aquatic habitat types were defined within the study reach based on hydraulic, geomorphological, and ecological criteria: main channel, natural banks, revetted banks, sandbars, dike fields, permanent and temporary secondary channels, abandoned river channels (Types I and II), oxbow lakes, borrow pits, and inundated floodplain. By use of controlled aerial photography and hydrographic survey data, aquatic habitat surface acreages were computed for three river stages (low flow= +13.2 ft, medium flow= +24.6, and high flow= +38.4 ft on the Greenville, MS gage). Results of the habitat mapping revealed a significant change in total aquatic habitat acreage with changes in river stage and discharge. At the low flow stage 18,581 acres of habitat were present. Habitat area increased to 29,020 acres at medium flow and rose to 56,902 acres for high flow, a total increase of 222% in area over low flow conditions. The main channel was the predominant habitat type during the low flow period, composing 45% of total habitat. Dike fields and the main channel were the most abundant habitat types at medium flow, making up 28 and 29% of total habitat, respectively. For the high flow period, inundated floodplain habitats were the most common habitats, comprising 27% of the total aquatic habitat. Variation in river stage and discharge caused a significant change in the spatial relationships.
W86-00373

STABILITY OF ARTIFICIALLY-DRAINED LOWLANDS: A THEORETICAL ASSESSMENT,

Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
J. D. Phillips.
Ecological Modelling, Vol. 27, No. 1/2, p 69-79, March, 1985. 2 Fig, 1 Tab, 31 Ref.

Descriptors: *Model studies, *Drainage systems, *Artificial watercourses, *Wetlands, *North Carolina, Stability, Lowlands, Water resources development, Environmental effects.

The impacts of artificial land drainage on wetlands was investigated, using coastal plain lowlands of North Carolina as an example, from a holistic viewpoint. The rate of drainage channel degradation following construction of artificial drainage networks appears to be the key variable determining stability of surface hydrologic systems. If degradation is rapid, the system is metastable and a new equilibrium may be achieved within a few years, though a return to the pre-alteration state is unlikely. Limited data available in the North Carolina coastal plain indicate that artificially-drained lowland hydrologic systems are metastable. Ditch and canal degradation is rapid after initial disturbance, but unmaintained channels do persist. More data are needed, however, on rates and processes of drainageway degradation and on the persistence of manmade stream networks. It appears that regular dredging, re-excavation, snagging, and vegetation removal in ditch-and-canal systems in North Carolina is limiting the ability of natural systems to adjust to perturbations and is maintaining the hydrologic system and, by extension, the ecosystem, in an unstable state. (Baker-IVI)
W86-00434

CONCORDANT VARIATION IN THERMAL TOLERANCE AND ALLOZYMES OF THE RED SHINER, NOTROPIS LUTRENSIS, INHABITATING TAILWATER SECTIONS OF THE BRAZOS RIVER, TEXAS,

North Texas State Univ., Denton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W86-00452

PROBLEM OF SARDINE FISHERIES IN EGYPT,

Institute of Oceanography and Fisheries, Alexandria (Egypt).
For primary bibliographic entry see Field 5C.
W86-00525

ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT OF THE JONGLEI CANAL PROJECT, SOUTHERN SUDAN,

Khartoum Univ. (Sudan). Inst. of Environmental Studies.
A. I. Moghraby, and M. O. Sammani.
Environmental Conservation, Vol. 12, No. 1, p 41-48, 1985. 2 Fig, 64 Ref.

Descriptors: *Environmental effects, *Social aspects, *Economic aspects, *Jonglei Canal, *Sudan, Cost-benefit analysis, Ecological effects.

The environmental and socio-economic impacts, as presently understood, of the Jonglei Canal project, southern Sudan, are reviewed, and it is concluded that completion of the project is justified both in terms of short- and long-term cost/benefit perspectives. Plankton and limnology, aquatic macrophytes, benthos and insect fauna, fish and fisheries, geography and geology, and wildlife are reviewed, and the socio-economic background of the 'Sudd' area is reviewed. Claims made for and against the building of the canal are reviewed, and possible changes in water quality, fisheries, and large wildlife are discussed. If the Jonglei Canal project is completed as planned, a new mode of life for both man and domestic and wild animals is anticipated. This new mode of life will be more satisfactory than the today's situation, which is already changing as the result of other causes unrelated to the canal project. (Rochester-IVI)
W86-00557

EFFECTS OF HUMAN ACTIVITIES ON ZAMBIA'S KAFUE FLATS ECOSYSTEMS,

Akron Univ., OH.
W. A. Sheppe.
Environmental Conservation, Vol. 12, No. 1, p 49-57, 1985. 8 Fig, 29 Ref.

Descriptors: *Environmental effects, *Kafue Flats, *Zambia, Dam effects, Flooding, Wildlife, Habitats, Vegetation, Aquatic plants, Water management.

The Kafue Flats, a 6,000 sq km floodplain area of the Kafue River, Zambia, has been affected by construction of two hydroelectric dams, one above the Flats at Itezhitezhi and another downstream from the Flats in the upper Kafue River Gorge. The Flats was studied for 12 mo in 1967-68, was visited in 1970 and 1971, and was studied for 6 wk in May-June 1983. In 1967, periodic flooding contributed to the support of a dense growth of emergent grasses across much of the area. Large herds of lechwe (Kobus leche), smaller numbers of zebra (Equus burchelli), wildebeest (Connochaetes taurinus), and other ungulates fed on the high ground, while one of the world's greatest agglomerations of avian biomass occupied the floodwaters and shoreline. At the same place in May 1983, the lower elevations on the floodplain were covered by permanent open water, and the higher elevations were perhaps permanently dry. The very productive vegetation had been largely replaced by aquatic plants in the open water, whereas the dry former floodplain had a sparse cover of low grasses and was being invaded by woody plants. There were few birds, relatively few lechwe, and no other large ungulates. Numerous less conspicuous changes had occurred in the vegetation, insect, bird, and small mammal populations. The effect of the dams was obscured by the effects of drought, hunting, and human use of the area. The long-term effects of the dams on the Kafue Flats are not now clear. Scheduled water releases or diking schemes

to control water in certain areas are alternatives that could help preserve wildlife habitat on the floodplain, but they conflict with maximum power generation, which is the current top priority for this system. (Rochester-IVI)
W86-00558

PROBLEM OF PEOPLE: CRITICAL AREAS AND FLOATING ZONES IN THE CHESAPEAKE,

Briscoe, Kenney, Kaminetz and Lacer, Lexington Park, MD.
For primary bibliographic entry see Field 6E.
W86-00573

INTERAGENCY DISPUTES OVER DRY FIELDS OR CLEAN WATER: A CASE STUDY OF THE CONFLICT BETWEEN AGRICULTURAL DRAINAGE PROGRAMS AND THE CHESAPEAKE BAY CLEANUP,

Arnold and Porter, Washington, DC.
T. J. Lindon, and M. P. Gergen.
Virginia Journal of Natural Resources Law, Vol. 4, No. 2, p 219-262, 1985. 241 Ref.

Descriptors: *Drainage effects, *Chesapeake Bay, *Water quality control, *Environmental effects, Upper Chester River Project, Maryland, Aquatic plants, Nutrients, Channeling.

The Environmental Protection Agency (EPA) study of the Chesapeake Bay has documented and substantial contribution made by agriculture to the deterioration of water quality of the Bay in terms of increased levels of nutrients in the water, decreases in numbers of submerged aquatic plants, and destruction of wetlands and associated vegetation. The Soil Conservations Service's (SCS) proposed Upper Chester River (Maryland) Project proposes to channelize streams to improve drainage on 9,400 acres of currently wet cropland and 5,200 acres of interdependent non-wet cropland. SCS did not adequately consider the adverse environmental consequences of this project in its Environmental Impact Statement (EIS), nor has it heeded or explored warnings of other government agencies with environmental expertise. These agencies lack effective mechanisms for forcing SCS to respond to their environmental concerns. In light of the Upper Chester River example, new approaches seem appropriate in three areas: (1) consideration of alternatives to channelization projects, since their negative environmental consequences are becoming more and more evident, (2) more attention by SCS to the concerns of other government agencies with more environmental expertise; this could be done in the forthcoming Supplemental EIS, and (3) the use by EPA of its as yet untested preemptory authority under section 404(c) of the Federal Water Pollution Control Act, which would allow it to prohibit, prospectively, the discharge of dredged or fill material at a particular site. (Rochester-IVI)
W86-00574

ECOLOGICAL ALTERATIONS OF IOWA PRAIRIE-AGRICULTURAL STREAMS,

Iowa State Univ., Ames. Dept. of Animal Ecology.
B. W. Menzel, J. B. Barnum, and L. M. Antosch.
Iowa State Journal of Research, Vol. 59, No. 1, p 5-30, August, 1984. 2 Fig, 10 Tab, 38 Ref. EPA grant R807122.

Descriptors: *Iowa, *Land use, *Streams, *Ecological effects, *Agriculture, Prairies, Sediments, Water quality, Habitats, Invertebrates, Fish, Nutrients, Channelization.

Water quality, habitat structure, and macroinvertebrate and fish communities were surveyed in 1979-1980 in ten headwater streams of the Cedar River basin. All streams are affected by moderate to intensive agricultural land use in their watersheds, and the purpose of the study was to describe stream ecological changes caused by this influence. Most streams carried heavy sediment and nutrient loads, had fine-particulate substrates, were extensively channelized, had a wide range in daily flows, and were largely devoid of instream vegetation. Water quality was highest and habitat structure was most complex in a woodland stream, and a pattern of environmental differences was measured among the nine prairie streams. Invertebrate communities were dominated by the collector-scraper functional assemblage. Shredders were primarily represented by amphipods, isopods, and crayfish. Ten fish species, mainly minnows, were identified as fish community dominants in all streams. Eight environmentally sensitive species were absent or present in only small numbers. The streams were classified into four groups on the basis of 12 biotic and abiotic characteristics which serve to provide a composite measure of ecological change from presumptive natural conditions. (Author's abstract)
W86-00581

ISSUES IN THE JAMES RIVER CORRIDOR,

Richmond Regional Planning District Commission, VA.
D. Arkin.
Virginia Journal of Science, Vol. 36, No. 1, p 7-13, 1985.

Descriptors: *Resources management, *James River, Virginia, Land use, Water supply, Water demand, Transportation, Urban areas, Recreation, Industries, Wastewater treatment, Environmental effects.

The role of the James River in the lives of the people living near it is large, including its use for water, transportation, recreation, industry, wastewater treatment, and a natural environment. The projected addition of more than 100,000 people to the Richmond Region by the year 2000 raises several issues affecting the river, including: water supply for power generation, human consumption, and industry, which is both a public health and economic issue, preservation of historic places and scenic areas associated with the James River, development of recreation and tourism, accomodation of growth pressures from residential, commercial, and industrial development, which requires control of land use, protection of the agricultural potential of the Richmond Region, and transportation problems associated with river use, access to the river, and the river as a barrier. A goal relating to these issues should be to determine 'reasonable and appropriate' uses of land in the James River corridor that meet the needs of the community and are compatible with what the land can best support. (Rochester-IVI)
W86-00582

HUMAN ECOLOGY OF THE JAMES RIVER,

Richmond Univ., VA. Dept. of Biology.
For primary bibliographic entry see Field 4C.
W86-00583

MODIFICATION OF THE JAMES RIVER,

Corps of Engineers, Norfolk, VA. Norfolk District.
F. T. Wootton, Jr.
Virginia Journal of Science, Vol. 36, No. 1, p 19-25, Spring, 1985. 7 Fig.

Descriptors: *James River, *Kepone, *Dredging, *Turbidity, Suspended solids, Environmental effects, Water resources development.

The James River Basin is 225 miles long, averaging 40 to 50 miles in width. The navigation portion of the James River is located at and downstream from Richmond. The Federal navigation project, authorized in 1870, is maintained so as to provide a channel 25 feet deep and 200 to 300 feet wide from Hampton Roads upstream to the Deepwater Terminal at Richmond. For a maintenance dredging project, a hydraulic pipeline cutterhead dredge was converted by fitting it with a dustpan head and ladder, to test the efficiency, output and environmental impacts while dredging in the James River. An environmental monitoring program was in place during the dredging tests, concentrating mainly on Kepone and turbidity. Material was deposited in the open water areas about 1,000 feet from the channel. Neither turbidity nor kepone levels increased significantly above background in the water column around the dredge head for either the dustpan or the cutter mode of dredging operation. The situation differed at the disposal area. While the turbidity and suspended solids in this area were similar, but slightly higher during the cutter mode, the dissolved kepone levels for the cutterhead averaged more than three times the levels during the dustpan mode. This may be explained by the fact that the cutterhead moved more than five times the amount of material moved by the dustpan, during more or less equal periods on the calendar. Overboard disposal proved to be economical and without serious environmental effects. (Baker-IVI)
W86-00584

JAMES RIVER FISHERIES AND THERMAL EFFECTS,

Richmond Univ., VA.
W. S. Woolcott.
Virginia Journal of Science, Vol. 36, No. 1, p 26-29, Spring, 1985. 6 Ref.

Descriptors: *Fisheries, *Environmental effects, *Thermal pollution, *James River, *Virginia, *Powerplants, Water resources development, Nuclear powerplants, Fish, Heated water, Water pollution effects.

Fishes represent the top trophic level in the James River, Virginia as they usually do in other aquatic habitats. Since the 1950's literally hundreds of studies of the effects of temperature on fishes have been made. Three electric power stations are discussed, Bremo Power Station, Chesterfield Power Station and Surry Power Station, which produce approximately one third of Vepco's total daily electric power output. The immediate impact of their heated effluents on fisheries in the James River is minimal and restricted to the nearby vicinity of the power station. Bremo Power Station impacts on the Piedmont part of the James. The impact is confined mainly to the first km below the outfall. Only occasionally were plume temperatures as far as 8 km downstream considered high enough to have a significant effect on fishes. Chesterfield Power Station is located near the upper reaches of the tidal James, in the middle of the spawning area of several anadromous species. Even so, the effect of this plant seems very small. Surry Power Station, the only nuclear fueled James River power station, is the only one specifically designed from day one to reduce its impact on the environment. Several features of the station have been responsible for the greatly reduced impact it might have otherwise had on the environment. When results of the environmental impact studies of the three James River power stations are compared it appears that they have in common a negligible, short term detrimental effect on fisheries. (Baker-IVI)
W86-00585

PECULIAR STRUCTURE OF THE TULAREMIA NATURAL FOCUS IN THE DON RIVER DELTA WITH SPECIAL REFERENCE TO ECONOMICAL INFLUENCE (SOVREMENNAYA STRUKTURA PRIRODHOGO OCHAGA TULYAREMII DEL'TY DONA V SVYAZI S KHOZYAISTVENNYM VOZDEISTVIEM),

Nauchno-Issledovatel'skii Protivochumnyi Inst., Rostov-na-Donu (USSR).
M. G. Protopopyan, V. G. Nalyotov, G. M. Medinskii, M. Ya. Semyonov, and A. E. Zakrutkin.
Zoologichesky Zhurnal, Vol. 64, No. 3, p 468-471, March, 1985. 1 Tab, 7 Ref.

Descriptors: *Public health, *Tularemia, *Rodents, *Don River Delta, *USSR, River flow, Fish farms, Drainage effects, Environmental effects, Epizootics.

Thirty years of economical usage of the Don River delta did not result in elimination of the tularemian epizootia. Anthropogenic factors (control of river flow, construction of fish farms, high roads, melioration and drainage) ensured the formation of peculiar, not characteristic of the classical foci of this type, faunistic complexes of rodents and changed

the focus spatial and biocoenotic structure. (Author's abstract)
W86-00593

7. RESOURCES DATA

7B. Data Acquisition

PHOTOGRAMMETRIC TECHNIQUES FOR MONITORING SOIL EROSION,

Georgia Univ., Athens. Dept. of Geography.
For primary bibliographic entry see Field 2J.
W86-00342

GROUNDWATER MONITORING AND SAMPLE BIAS,

Waterloo Univ. (Ontario). Dept. of Earth Sciences.
R. W. Gillham, M. J. L. Robin, J. F. Barker, and J. A. Cherry.
American Petroleum Institute, Washington, DC., June, 1983, 206 p. 40 Fig, 14 Tab, 120 Ref.

Descriptors: *Monitoring, *On-site data collections, *Sampling, *Water sampling, *Reviews, *Water quality, *Groundwater pollution, Data interpretation, Data aquisition, Data collections, Groundwater, Water properties, Chemical properties, Physical properties.

The factors which can lead to uncertainty in groundwater quality data are systematically reviewed. Hydrogeologic factors which may cause bias or uncertainty are variations in regional flow characteristics, in physical and chemical controls on contaminant migration, and in porosity of media and hydraulic conductivity. Sample integrity can also be a potential source of bias in the evaluation of groundwater quality. Processes which may cause a loss in sample integrity include contamination of the geologic materials in the vicinity of the intake zone of the sampling installation by drilling, contamination from the instillation equipment or sampling materials, and contamination by sample degassing and volatilization or atmospheric substances. Human error may also affect sample integrity. The geochemical characteristics of several groundwater contamination parameters (pH, specific conductance, total organic carbon and total organic halogen) and the particular sampling precautions that are required for each are discussed. Particular consideration is given to the 29 parameters listed in the Resource Conservation and Recovery Act of the U. S. Environmental Protection Agency. In addition, four specific gasoline components are examined. Sampling objectives, data management and tests of difference, and sampling in the unsaturated zone are also discussed.
W86-00345

TRANSPORT, FATE AND EFFECTS OF ENERGY-RELATED POLLUTANTS: EVALUATION OF SURFACE AND GROUNDWATERS; APPENDIX 1: PRELIMINARY LISTING OF SENSITIVE SURFACE WATERS,

Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
For primary bibliographic entry see Field 5B.
W86-00348

CHARACTERIZATION OF BENTHIC MICROHABITAT; AN EXPERIMENTAL SYSTEM FOR AQUATIC INSECTS,

Illinois Univ. at Urbana-Champaign. Dept. of Urban and Regional Planning.
For primary bibliographic entry see Field 2H.
W86-00443

DESIGN AND INSTALLATION OF LARGE WEIGHING LYSIMETERS,

Agricultural Research Service, Bushland, TX. Conservation and Production Lab.
For primary bibliographic entry see Field 2D.
W86-00489

AUTOMATION OF A CLASS A EVAPORATION PAN,

Agricultural Research Service, Mississippi State, MS. Crop Simulation Research Unit.
For primary bibliographic entry see Field 2D.
W86-00499

DROP SIZE DISTRIBUTION MEASUREMENT PROBLEMS USING A LASER UNIT,

South Dakota State Univ., Brookings. Dept. of Plant Science.
R. A. Kohl, R. D. von Bernuth, and G. Huebner.
Transactions of the American Society of Agricultural Engineers, Vol. 28, No. 1, p 190-192, January/February, 1985. 4 Fig, 3 Ref.

Descriptors: *Lasers, *Measuring instruments, *Drop size, Sprinklers, Rain, Fluid drops,.

A He-Ne laser raindrop measurement unit was compared to the flour method for measuring raindrop size distributions from an agricultural sprinkler (spray type, 9.5 mm nozzle). The laser unit recorded fewer small droplets and more large drops compared to the flour method. Drops larger than the largest stable drop size were recorded by the laser system, even into the 8, 9, and 10 mm size classes. Recording of such drops resulted from two or more drops falling through the laser sensing area, one behind the other, in the 500 mm depth of field and somewhat offset. The result was coincidence error; recording of two or more drops as one larger drop. The probability of coincidence is very low (0.09% for a 2.5 mm drop at 50 mm/hr intensity) for a natural rain, but it increases to 5.3% for a 1.25 mm drop event at 500 mm/hr as occurs with an agricultural sprinkler. If 5.3% of the drops are incorrectly measured as twice as large as they really are, a volume error of 37% results. Several techniques were tried to remove the coincidence error from data, but without success. The laser system is therefore recommended for rainfall, but not for use with agricultural sprinklers. (Rochester-IVI)
W86-00502

USE OF DIALYSIS CELLS FOR INVESTIGATING PORE WATER COMPOSITION IN WETLAND SUBSTRATA, WITH PARTICULAR REFERENCE TO DISSOLVED IRON AND SULPHIDE,

Sheffield Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W86-00511

LANDSAT STUDY OF THE AQUATIC VEGETATION OF THE LAKE LUODONJARVI RESERVOIR, WESTERN FINLAND,

Oulu Univ. (Finland). Dept. of Astronomy.
For primary bibliographic entry see Field 2H.
W86-00532

RECORDING ECHO SOUNDER FOR ASSESSING SUBMERGED AQUATIC PLANT POPULATIONS IN SHALLOW LAKES,

Agricultural and Food Research Council, Oxford (England). Weed Research Organization.
C. J. Stent, and S. Hanley.
Aquatic Botany, Vol. 21, No. 4, p 377-394, April, 1985. 11 Fig, 2 Tab, 5 Ref.

Descriptors: *Aquatic plants, *Submerged plants, *Echo sounders, Remote sensing, Lakes, Water depth, Mapping.

This paper describes the design of a recording echo sounder which has a depth range of 6 m and can be used in shallow lakes and rivers to determine submerged plant heights and water depths. The instrument uses mainly digital techniques, has a liquid crystal display, and records echoes on standard audio cassettes. These are returned to the laboratory for analysis, using a microcomputer to produce various maps of the data. This system has been successfully used to map plant populations at several sites, the data for which are given. (Author's abstract)
W86-00533

8. ENGINEERING WORKS

8A. Structures

VALIDATION REPORT: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA),

Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing Center.
W. A. Price, R. L. Hall, R. L. Mosher, C. C. Hamby, and R. Veselka.
Instruction Report K-81-3, February 1981. Final Report. 375 p.

Descriptors: *Structural engineering, *Soil mechanics, *Computer programs, *Design criteria, *Retaining walls, Walls, Load distribution, Stability analysis, Earth pressure, Soil pressure, Hydrostatic pressure, Seepage, Soil properties, Shear, Friction, Compressive strength, Earthquake engineering, Seismic properties, Water pressure, Reinforced concrete, Concrete, Stress, TWDA program.

Sample problems and their solutions verify the computer program TWDA (T-wall design/analysis), which is a user-oriented interactive, modular time-sharing program to aid in structural design and analysis of inverted-T retaining walls and floodwalls founded on earth or rock. The program has three major sections: executive command phase, stability modules (compute active earth pressures and determine overturning and sliding stability), and structural modules (perform stress analysis of the wall or design for minimum slab thickness). The program's goals are (1) a minimum-cost adequate design based on current codes and criteria, independent of the user's experience and (2) encouragement of personal judgment and imagination through interaction.
W86-00318

OVERVIEW OF THE TENNESSEE-TOMBIGBEE WATERWAY,

Corps of Engineers, Mobile, AL. Mobile District.
S. R. Green.
Environmental Geology and Water Science, Vol. 7, No. 1/2, p 9-13, 1985. 1 Tab.

Descriptors: *Tennessee-Tombigbee Waterway, *Water resources development, Mississippi, Alabama, Waterways, Construction, Lakes, Engineering, Navigation, Recreation.

When the Tennessee-Tombigbee Waterway of Mississippi and Alabama opened to commercial and recreational traffic on January 16, 1985, some 21 months ahead of schedule, it signaled the completion of the largest Army Corps of Engineers Civil Works project ever undertaken. The feasibility of the project was first studied by the Corps more than 110 years ago, but not reported as economically justified until 1938. Construction was authorized in 1946 by the River and Harbor Act which provided for a waterway connection between the inland navigation systems of the Tennessee, Ohio, and upper Mississippi Rivers, and the navigable Black Warrier-Tombigbee River System which connects with the port of Mobile. The waterway is divided into three distinct sections depending on the means of construction. The utilization of different design and construction techniques was a balance of economics, construction capability, and environmental concern. The 10 lakes formed in the construction of the waterway impound 44,000 acres of water, used for recreation purposes as well as navigation. The benefits derived from the Tennessee-Tombigbee Waterway are virtually all transportation savings resulting from use of the waterway as opposed to alternate routes or modes of transportation. Recreation and fish and wildlife habitat enhancement amounted to only a few percentage points of the total benefits. (Baker-IVI)
W86-00332

CREATIVE SPOIL: DESIGN CONCEPTS, CONSTRUCTION TECHNIQUES, AND DISPOSAL OF EXCAVATED MATERIALS,

Louisiana State Univ., Baton Rouge. School of Environmental Design.
G. J. McLindon.
Environmental Geology and Water Science, Vol. 7, No. 1/2, p 91-108, 1985. 10 Fig, 4 Tab, 11 Ref.

Descriptors: *Tennessee-Tombigbee Waterway, *Construction, *Design criteria, *Spoil disposal, Planning, Water resources development, Excavation, Environmental effects, Waterways.

Construction methods used in building the Tennessee-Tombigbee Waterway are reviewed including the disposal of surplus excavated materials and the reclamation of disposal areas along the waterway. Emphasis is placed on the steps taken to assure protection of natural resources and to promote overall enviromental quality. The overall design of the waterway and disposal of excavated materials was imaginative and positive, taking advantage of natural topography and utilizing techniques devised to overcome and accommodate the difficulties encountered. In keeping with the objective of locating disposal units in the least sensitive areas, three disposal sites utilized abandoned gravel pits, two sites being completely contained within the mined out area, the third partially contained. The vast majority of areas had no predetermined development use and, being in the floodplain, were designated as prime wildlife habitat locations. Investigation of several completed disposal areas indicate that natural revegetation is occurring at a satisfactory rate and that the natural flora contains an abundance of wildlife food plants. The disposal of hydraulically dredged material along the river section of the Tenn-Tom Waterway could have created massive long range environmental impacts. From the outset a positive attitude directed the methods of disposal into creative ventures. (Baker-IVI)
W86-00337

SELF-CLEANING, NON-POWERED TRASH SCREENS FOR SMALL IRRIGATION FLOWS,

Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.
For primary bibliographic entry see Field 4A.
W86 00490

8B. Hydraulics

BANK PROTECTION TECHNIQUES USING SPUR DIKES,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Copeland.
Miscellaneous Paper HL-83-1, January 1983. Final Report. 32 p, 22 Fig, 2 Tab, 24 Ref.

Descriptors: *Hydraulics, *Erosion control, *Bank protection, *Dikes, Scour, Protection, Channel erosion, Stream banks, Hydraulic models, Model studies.

The effects of impermeable spur dikes as a bank protection technique in a concave bend were studied with a hydraulic model. The tests were conducted to observe channel bed and bank response in a stream with noncohesive banks where suspended load is insignificant. The following conclusions were reached. Spacing-to-length ratios up to three may be effective in protecting concave banks with spur dikes; however, some bank protection may be needed. Spur dike roots should be protected from scour caused by vortices set up along the upstream and downstream faces. The spur dike should be aligned perpendicular to the bank or current. Aprons effectively limit the depth of scour at the dike's toe. The development of a scour hole at the dike toe may be slowed by the formation of an armor layer. Existing equations for scour prediction at spur dikes may not be applicable to dikes in concave bends.
W86-00311

PREVENTION OF SHOALING AT LITTLE LAKE HARBOR, MICHIGAN: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
W. C. Seabergh, and J. W. McCoy.
Technical Report HL-82-16, July 1982. Final Report. 373 p, 28 Fig, 8 Tab, 293 Plates, 13 Ref.

Descriptors: *Hydraulics, *Breakwaters, *Lakes, *Sedimentation, *Shore protection, Hydraulic models, Model studies, Shoals, Protection, Little Water Harbor, Michigan, Lake Superior, Channels, Boating, Navigation, Seiches.

A 1:75-scale hydraulic model was used to study the breakwater structures at Little Lake Harbor, Michigan, on the south shore of Lake Superior. Existing breakwaters have not prevented extensive shoaling in the entrance channel. It was determined that seiche oscillations with periods near the inlet-bay Helmholz period occurred frequently. These oscillations could generate velocities as high as 4.5 fps in the entrance channel, with a median velocity of 0.62 fps. Model tests indicated an optimum plan--a 570-ft long detached dogleg breakwater on the east side of the entrance. This structure would allow the gap between the new breakwater and the shore to close from sediment deposition. Adding a caisson at the lakeward terminus would not adversely impact shoaling patterns. This plan would also provide a straight-in approach for boat traffic and reduce seiche oscillations in the harbor and velocities in the entrance.
W86-00317

BOUNDARY-FITTED COORDINATE CODE FOR GENERAL TWO-DIMENSIONAL REGIONS WITH OBSTACLES AND BOUNDARY INSTRUSIONS,

Mississippi State Univ., Mississippi State. Dept. of Aerospace Engineering.
J. F. Thompson.
Technical Report E-83-8, March 1983. Final Report. U.S. Army Environmental and Water Quality Operational Studies, Army Engineer Waterways Experiment Station, Vicksburg, MS. 80 p, 20 Fig, 12 Ref.

Descriptors: *Computer models, *Computer programs, *Mathematical studies, Flow, Differential equations, Finite difference methods, Numerical analyses, Boundary processes.

A code (WESCOR) for the generation of boundary-fitted coordinate systems for general two-dimensional regions with boundaries of arbitrary shape and with internal obstacles and boundary intrusions, arbitrary in shape and number, is described and instructions for input and use are given. The coordinate system is generated from the numerical solution of a system of elliptic partial differential equations with provision for controlling the spacing of the coordinate lines in the field. The transformed (computational) region is rectangular with the obstacles and intrusions transformed to slits and/or slabs. A small code to distribute points on various fundamental curves with exponential concentration is also described. This procedure will be particularly useful where numerical models are used to analyze flow problems with complex boundary conditions. Typical examples are riverine analysis or the design and evaluation of selective withdrawal outlet works. (Author's abstract, modified)
W86-00323

DESIGN FOR FLOOD CONTROL, WAVE PROTECTION, AND PREVENTION OF SHOALING, ROGUE RIVER, OREGON: HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
R. R. Bottin.
Technical Report HL-82-18, August 1982. Final Report. 577 p, 6 Fig, 25 Tab, 424 Photos, 41 Plates, 21 Ref, Append.

Descriptors: *Hydraulics, *Shoals, *Jetties, *Sedimentation, *Shores, *Flood control, Hydraulic models, Model studies, Wave action, Rogue River, Oregon, Rivers, Dredging, Dikes, Harbors.

A 1:100-scale hydraulic model was used to investigate the effects of proposed improvements in the Rogue River, Oregon, harbor area with respect to shoaling, wave action, and riverflow conditions. The proposed improvements included (1) extensions and/or modifications of the present jetties, (2) dredging of a new entrance channel south of the existing one with an extension of the south jetty and construction of a new jetty, and (3) installation of dikes extending into the channel from the south jetty both with and without a weir section and conveyance channel installed on the north jetty and overbank. Several structures proved ineffective or caused new problems--a timber-pile dike extending from the south jetty, rubble-mound dikes, conveyance channel and weir section, and some configurations of jetty extensions. A plan involving a new harbor entrance south of the existing river mouth would cause a natural bypassing condition where the sediment on the north shoreline moves around the new middle jetty and toward the south shoreline. Wave heights in the harbor would be less than 1 ft for this plan.
W86-00326

HYDRAULIC MODEL STUDY OF CHOKE CANYON DAM SPILLWAY AND STILLING BASIN,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
R. L. George.
Report No. GR-82-9, August 1982. 30 p, 25 Fig, 3 Ref.

Descriptors: *Hydraulic models, Spillways, *Stilling basin, *Model studies, *Scour, Basins, Froude number, Riprap, Channel scour, Approach channels, Choke Canyon Dam, Texas.

A 1:80 scale hydraulic model of the Choke Canyon Dam spillway and stilling basin was studied. The dam will be 35 m high and have a crest length of 5,640 m. The spillway chute is 112.2 m wide and has a Froude number of about 4.4 at the stilling basin entrance. The stilling basin was designed to criteria developed for low Froude number flows. A modified entrance channel was developed as the model was tested. Stilling basin walls were shortened as a result of model studies. A 14-meter apron having 32 m of riprap extended downstream from the end sill was recommended. The design worked well for all discharges and scour was limited to an area downstream from the riprap.
W86-00382

LAKE SHERBURNE DAM MODEL STUDY,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
B. W. Mefford.
Report No. GR-82-15, September 1983. 32 p, 23 Fig, 5 Ref.

Descriptors: *Hydraulic models, *Flow characteristics, *Spillway capacity, *Flow resistance, *Cavitation, Spillways, Outlets, Tunnel hydraulics, Channel flow, Lake Sherburne Dam, Flow, Montana.

Hydraulic model studies, on a 1:15 scale model of Lake Sherburne Dam, were conducted to evaluate flow conditions in the spillway and outlet works tower structure during the passage of the IDF (inflow design flood). Model tests on the existing structure revealed two areas where pressures were consistently negative, and a third area where intermittent roller vortices occurred during submerged spillway flows. A crown flow constriction was placed in each tunnel, downstream of the low pressure areas, in the hydraulic model. The constrictions were designed in conjunction with downstream air venting. The shape and location of these constrictions were changed several times to determine the discharge capacity versus localized upstream pressure recover. Nonsymmetric crown flow constrictions provided sufficient back pressure to raise the consistently low-pressure areas to acceptable levels during the design discharge. Roller vortices occurred due to a 90 deg square-edged flow boundary on each side of the tower

structure. Large radius fillets were placed in the 90 deg corners to eliminate the vortex action.
W86-00383

8D. Soil Mechanics

VALIDATION REPORT: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA),

Army Engineer Waterways Experiment Station, Vicksburg, MS. Automatic Data Processing Center.
For primary bibliographic entry see Field 8A.
W86-00318

UNWATERING THE DIVIDE CUT OF THE TENNESSEE-TOMBIGBEE WATERWAY; A MAJOR CHALLENGE TO CONSTRUCTION,

Army Engineer District, Nashville, TN.
M. D. Simmons.
Environmental Geology and Water Science, Vol. 7, No. 1/2, p 51-67, 1985. 10 Fig, 1 Tab, 21 Ref.

Descriptors: *Tennessee-Tombigbee Waterway, *Construction, *Divide Cut, *Dewatering, Excavation, Canals, Water resources development, Groundwater.

The construction of the Divide Cut of the Tennessee-Tombigbee Waterway required excavation of more than 150 million cu yd of unconsolidated sand and clay. A project of this magnitude was unprecedented for the Corps of Engineers. The excavation of the unconsolidated materials required the lowering of the artesian groundwater by an average of over 50 feet in order to construct and maintain safely and economically the side slopes of the canal. The materials excavated were fine-grained sand with thin layers of interbedded clay at intervals ranging from a few inches to 10 feet or so. The artesian pressures were lowered to a safe level through the use of deep wells while the remaining interstitial water was removed to the extent necessary for equipment excavation by narrow trenches constructed ahead of mass excavation. Numerous piezometers were used to monitor the lowering of the artesian groundwater pressures as the excavation progressed. The project has demonstrated that soil materials in areas of high artesian heads can be safely excavated by lowering the artesian pressures with deep wells and can be sufficiently unwatered with trenches so rubber-tired equipment can be used for excavation. Large-scale field testing proved to be of extreme value in developing appropriate construction techniques and is considered to be a necessary component in order to successfully produce a design for any project of this magnitude. (Baker-IVI)
W86-00335

CEMENT-MODIFIED SOIL IN CANAL LINING,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8F.
W86-00381

8E. Rock Mechanics and Geology

HYDROGEOLOGICAL AND GEOTECHNICAL ASPECTS OF THE TENNESSEE-TOMBIGBEE WATERWAY,

Corps of Engineers, Mobile, AL. Mobile District.
J. H. Bryan.
Environmental Geology and Water Science, Vol. 7, No. 1/2, p 25-50, 1985. 17 Fig, 3 Tab, 10 Ref.

Descriptors: *Water resources development, *Tennessee-Tombigbee Waterway, *Hydrogeology, *Engineering geology, Canals, Waterways, Construction, Environmental effects, Earthquakes, Locks, Dams.

A few of the more significant hydrogeologic and geotechnical aspects of the Tennessee-Tombigbee Waterway are summarized. Some typical engineering and environmental problems are covered, along with a few of the more complex problems and how they were dealt with at specific sites. The concentration is primarily on the River and Canal sections of the Waterway. The general geologic setting is described with emphasis on seismicity, and mineral resources. Groundwater hydrology is described including hydrogeologic conditions along the flood plain, environmental and pre-construction investigations. Geotechnical explorations and design studies are reviewed along with optimizing conditions for the locating of locks and dams, the adaptation of design and construct to geologic conditions, construction dewatering for river and canal sections, impact on hydrogeologic and geologic environment, and continued monitoring and evaluation tasks. (Baker-IVI)
W86-00334

8F. Concrete

DESIGN OF DOWELS FOR ANCHORING REPLACEMENT CONCRETE TO VERTICAL LOCK WALLS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Structures Lab.
T. C. Liu, and T. C. Holland.
Technical Report SL-81-1, March 1981. Final Report. 77 p, 42 Fig, 13 Tab, 17 Ref, 2 Append.

Descriptors: *Concrete construction, *Steel, *Locks, Dowels, Design criteria, Waterways, Shear tests, Resins.

Dowel pullout tests and shear transfer tests were performed to evaluate the pullout performance of dowels and the influence of dowel spacing on the load carrying capacity of replacement concrete cast during rehabilitation of vertical walls in navigation locks. The dowels were installed with a polyester resin cartridge system. For embedment lengths less than 15 times the dowel diameter, failure was generally caused by slippage along the concrete-resin interface. Performance of dowels installed under field conditions was acceptable. Within the range of the percentage of steel used in the laboratory shear transfer tests, the effect of the dowels did not appear to increase significantly the load-carrying capacity of the test specimens. The bond between the new and old concrete was more significant than the amount of steel present. The coefficient of friction between the new and old concrete was 1.35. In failure tests two modes were observed. In specimens without dowels the new concrete suddenly dropped onto the old concrete. In specimens with dowels the dowels prevented complete separation of the two pieces of concrete.
W86-00312

CONCRETE PERFORMANCE AT PUEBLO DAM, COLORADO: INITIAL CORE REPORT,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
L. G. Mogck, and E. R. Dunstan.
Report No. GR-80-7, March 1982. 38 p, 10 Fig, 8 Tab, 6 Ref.

Descriptors: *Concrete technology, *Concrete testing, *Strength, Elastic properties, *Physical properties, *Concrete mixes, Concretes, Cores, Tensile strength, Compressive strength, Poisson ratio, Pozzolans, Pueblo Dam, Colorado.

Physical properties of initial cores extracted from the dam and river plug at Pueblo Dam, Colorado, indicate a good quality, uniform, well-consolidated concrete. This study is part of a series in the long-term evaluations of strength and elastic properties of concrete in various dams. The river plug concrete included two mix designs designated as interior and exterior. The dam concrete included two mix designs noted as high of low water to cement plus fly ash ratio. Results of the tests on the 3-year cores from the river plug show the average compressive strength of the concrete to be about 40 MPa, with no increase over the 6-month strength. The average 1-year dam concrete compressive strength was about 30 MPa, which is an increase over that at 6 months age. The modulus of elasticity for the interior plug concrete at 3 years is about 30 GPa with no significant increase with age. The 1-year dam concrete modulus of elasticity is about 35 GPa. Poisson's ratio, density, mix design, and tensile strengths of construction joints and monolithic specimens are also discussed.
W86-00380

CEMENT-MODIFIED SOIL IN CANAL LINING,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. W. Jones.
Report No. GR-82-4, August 1982. 31 p, 14 Fig, 3 Tab, 13 Ref, 2 Append.

Descriptors: *Cements, *Canal linings, *Erosion control, *Soil stabilization, *Soil cement, Canals, Silt, Loess, Portland cements, Erosion, Driftwood Canal.

In 1958, test sections of silty loessial soil lining treated with portland cement were installed on one side of the Driftwood Canal to resist erosion from water action. This canal, located near McCook, Nebraska, has a capacity of 6.3 cu m/s. The cement, in amounts of 4.5 percent by volume for one section and 2.5 percent for another was mixed with the soil in 600-mm-wide horizontal strips in the lining, which was otherwise constructed as a normal thick-compacted soil lining. In 1981, the cement-treated soil was sampled and laboratory compressive strength and durability tests were performed. Although the soil with 4.5 percent cement was cracked and had a blocky structure, it has resisted erosion reasonably well, even on a curve. The test reach with 2.5 percent cement resisted erosion slightly better on a straight section than the opposite untreated side. However, this section did not contain sufficient cement to adequately resist erosion on a curve.
W86-00381

CONCRETE PERFORMANCE IN MORROW POINT DAM: 10-YEAR CORE REPORT,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
O. R. Werner, and D. Mudrick.
Report No. GR-81-5, March 1981. 44 p, 7 Fig, 7 Tab, 1 Append.

Descriptors: *Concrete technology, *Cores, *Concrete testing, *Strength, *Elastic properties, *Physical properties, *Concrete dams, *Mass concrete, Tensile strength, Compressive strength, Poisson ratio, Morrow Point Dam, Colorado.

The Bureau of Reclamation monitors the structural behavior of concrete dams for many years after completion. Concrete core evaluation programs are also conducted at various ages on major dams. This report presents test results on concrete cores taken from Morrow Point Dam up to 10 years' age. The physical properties tests conducted on 250-mm(10-in) diameter cores at 60 days, 180 days, 1 year, 5 years, and 10 years indicate that overall condition of the concrete is good. The thin-arch design used at Morrow Point required a higher than normal compressive strength for mass concrete. Most mass concrete dams built previously contained interior and exterior mixes; however, with the higher compressive strengths maintained at Morrow Point, a single mix was sufficient for the entire structure. The compressive strength of the mass concrete at 10 years averaged 51.6 MPa (7,480 lb/sq in). Also at 10 years, the modulus of elasticity and Poisson's ratio averaged 35.1 GPa (5,090,000 lb/sq in) and 0.24, respectively. The tensile strength of all cores tested at 10 years averaged 1.59 MPa (230 lb/sq in), which is comparable to tensile strengths for other Service dams.
W86-00384

CONCRETE PERFORMANCE IN CRYSTAL DAM, COLORADO: 1-YEAR CORE REPORT,

Bureau of Reclamation, Denver, CO. Engineering and Research Center.
T. A. Gaeto.
Report No. GR-81-8, June 1983. 30 p, 9 Fig, 3 Tab,

4 Ref.

Descriptors: *Concrete testing, *Concrete dams, *Concrete technology, *Strength, *Elastic properties, *Physical properties, Concretes, Cores, Tensile strength, Compressive strength, Poisson Ratio, Construction joints, Crystal Dam, Colorado.

Results of physical properties tests conducted on cores extracted from mass concrete in Crystal Dam for testing at 70 days', 6 months, and 1 year's age indicate good quality, uniform, well-consolidated concrete. This report contains test data through 1 year's age and is a part of a series of reports on long-time evaluations of strength and elastic properties of concrete in major Bureau of Reclamation dams. The average compressive strengths at 6 months and 1 year were 33.7 and 35.0 MPa (4,890 and 5,080 lb/sq in), respectively, which represent an average strength gain of 3.9 percent. Paralleling the strength increase, the moduli of elasticity also increased slightly from 31.4 to 31.7 GPa (4,550,000 to 4,600,000 lb/sq in). Tensile strengths for jointed and nonjointed cores were comparable at 6 months, but the nonjointed 1-year tensile strengths averaged 40 percent higher. Ratios of tensile to compressive strengths were high, indicating good paste-aggregate bond. Discussions of test results, variations, construction joint bond, and Poisson's ratio are also included in the report.
W86-00385

8G. Materials

STANDARD NUMBER 54: FLEXIBLE MEMBRANE LINERS.
National Sanitation Foundation, Ann Arbor, MI.
November 1983. 70 p, 15 Tab, 8 Append.

Descriptors: *Materials engineering, *Polymers, *Plastics, *Membranes, *Linings, Polyethylene, Polyvinyl chloride, Rubber, Epichlorohydrin polymer.

Standards for flexible membranes are given for many polymeric materials. Of particular interest are standards for potable water applications, the aquatic environment, and construction. Flexible membranes used in fishing ponds, agriculture, fish hatcheries, and recreational reservoirs should not adversely affect the environment. If information on prior use of a particular membrane is not available, special studies may be required. Properties of the following materials are given: polyvinyl chloride. chlorinated polyethylene, butyl rubber, polychloroprene, high density polyethylene, ethylene-propylene diene terpolymer, epichlorohydrin polymers, polyethylene ethylene-propylene alloy, high density polyethylene elastomeric alloy, chlorosulfonated polyethylene, thermoplastic nitrile, ethylene interpolymer alloy, and chlorinated polyethylene alloy.
W86-00320

GENESIS OF THE PROTECTIVE LAYERS UPON THE MILD STEEL SURFACE IN THE NEUTRAL NATURAL WATERS,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia).
V. Bischof, and J. Elisek.
Acta Hydrochimica et Hydrobiologica, Vol. 12, No. 5, p 531-537, 1984. 2 Fig, 5 Tab, 8 Ref.

Descriptors: *Corrosion, *Steel, *Protective layers, Drinking water, Chlorides, Dissolved oxygen, Carbonates, Sulfates, Calcium, Magnitite, Alkaline earths.

Corrosion of mild steel in waters with dissolved oxygen takes place mostly with oxygen depolarization as the main reaction. The surface layer consists of the corrosion products and constituents of the surroundings. The formation of protective layers against corrosion was investigated by experiments performed in three different media: drinking water, drinking water enriched by chlorides and a concentrated chloride solution. The conditions for protective layer formation on mild steel in neutral water are given by the concentration of calcium and bicarbonate ions, which form layers of $CaCO_3$ and $FeCO_3$. During corrison processes nonstoichiometric hydrated magnetite is first formed. It is gradually oxidized and its structure changes to $FeOH.H_2O$. The natural water components increase the oxidation rate, they yield crystallization nuclei, and they affect the space structure of compounds formed during corrosion reactions. A high availability of alkaline earths and hydrogen carbonate allows the formation of a protective layer consisting of $FeOOH.H_2O$, $CaCO_3$ and $FeCO_3$. (Baker-IVI)
W86-00419

8I. Fisheries Engineering

HABITAT DEVELOPMENT FOR FRESHWATER MOLLUSKS IN THE TOMBIGBEE RIVER NEAR COLUMBUS, MISSISSIPPI,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Environmental Lab.
A. C. Miller.
In: Report of Freshwater Mollusks Workshop, May 19-20, 1981, Vicksburg, MS. Final Report, May 1982. p 86-94, 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Environmental effects, *Rivers, *Aquatic habitats, *Mollusks, Shellfish, Tombigbee River, Aquatic insects, Insects, Riffles, Channel improvement, Habitats.

The U.S. Army Engineer Waterways Experiment Station has begun a project to design and monitor a gravel bar habitat for aquatic insects and mollusks. This bar will be placed in the Tombigbee River near Columbus, Mississippi, river mile 232.9. This study has been divided into three phases: biological evaluation of the project area (to be initiated in the summer of 1981), design of the bar or bars, and subsequent monitoring of the habitat after construction by the U.S. Army Engineer District, Mobile. (Author)
W86-00330

COLUMBIA RIVER FISHERIES DEVELOPMENT PROGRAM ANNUAL REPORT - F.Y. 1981,
National Marine Fisheries Service, Seattle, WA.
R. Z. Smith, and E. Wold.
Available from the National Technical Information Service, Springfield, VA 22162 as PB83-11452 0. NOAA Technical Memorandum NMFS F/NWR-4, July 1982. 51 p. 13 Fig, 6 Tab, Append.

Descriptors: *Fisheries, *Fish hatcheries, Cost analysis, *Columbia river basin, Fish ladders, Salmon, Water pollution sources, Water pollution control.

FY 1981 was a very active year for the Columbia River Fisheries Development Program. Twenty-two hatcheries and two rearing ponds made releases during the year. The Toutle Hatchery, destroyed by the eruption of Mt. St. Helens, was mothballed until the habitat improves enough for anadromous fish to live in the Toutle River Basin. Stream improvement and irrigation diversion screening operated on a maintenance level. Only a few diversions in Idaho remain to be screened. All fish ladders were inspected by the operating agencies and repaired where necessary prior to the adult migration runs. Almost 3.5 million marked fall chinook were released from 18 hatcheries, of which 12 were funded under the Program, in 1981. One more year of marking remains in this four-year study. Initial data show that the fish are being caught in all the same fisheries as were fish from the 1961-64 fall chinook study. In 1981, the Program became directly involved with fish transportation in the Columbia River Basin. A total of > 8 million juvenile salmonids were trapped at Lower Granite, Little Goose, and McNary Dams and trucked/barged to a release site below Bonneville Dam. Activities during 1981 were mainly operational. By the close of 1981, pollution abatement facilities were completed and in operation at all Program hatcheries.
W86-00347

INFLUENCE OF THE FISH CLARIAS BATRACHUS ON THE PHYSICOCHEMICAL PROPERTIES OF WATER UNDER LABORATORY CONDITIONS,
Kalyani Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-00401

EVALUATION OF INSTREAM ENHANCEMENT STRUCTURES FOR SALMONID SPAWNING AND REARING IN A COASTAL OREGON STREAM,
Bureau of Land Management, Salem, OR. Salem District.
R. A. House, and P. L. Boehne.
North American Journal of Fisheries Management, Vol. 5, p 283-295, Spring, 1985. 5 Fig, 6 Tab, 21 Ref.

Descriptors: *Fisheries engineering, *Stream enhancement structures, *East Fork Lobster Creek, *Oregon, Salmon, Trout, Spawning, Streambeds, Stream rehabilitation.

East Fork Lobster Creek, Oregon is an example of a stream that lost much of its productivity as an anadromous salmonid stream following logging activities, intensive stream cleaning, and flooding. The stream in the study area was almost devoid of instream structures, resulting in a nearly total lack of spawning gravel and rearing habitat. Stream enhancement structures installed in East Fork Lobster Creek were successful and functional after two winters with usual freshets. The structures dramatically increased the diversity of the stream bed, trapped gravel, and created shallow gravel bars and deep, covered pools. Also, the number, size, and quality of the pools increased in areas with structures. Coho salmon (Oncorhynchus kisutch) and steelhead (Salmo gairdneri) spawning increased substantially, as well as the numbers of rearing coho, steelhead fry, and steelhead and cutthroat trout (Salmo clarki) parr. This study shows that similar degraded streams can be rehabilitated by properly designed enhancement programs. Such programs are effective and are needed to help ensure the protection of naturally spawning and rearing wild salmonid stocks and the survival of their young. (Author's abstract)
W86-00591

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

HAZARDOUS MATERIALS SPILLS-MANAGEMENT REVIEW,
Texas Transportation Inst., College Station.
J. T. Lamkin, D. P. Honan, J. A. Nickerson, J. L. Payne, and R. C. Speaks.
American Petroleum Institute, Washington, DC., 1981, 414 p. 5 Fig, 2 Tab, 5 Append.

Descriptors: *Oil spills, *Data collections, *Reviews, *Environmental protection, *Hazardous materials, *Transportation, *Education, *Data transmission, Data storage and retrieval, Data acquisition, Federal government, State governments, Management planning, Education, Training.

This study, funded by the American Petroleum Institute, addresses the problems associated with the safe and efficient transport of hazardous materials through the development of a materials transportation data base. It provides a state-of-the art examination of various inputs to the hazardous transportation file by providing the foundation for a broad based and comprehensive data base. The level of involvement by the federal government and state agencies in the field of hazardous materials transportation is documented. Methods for data development, maintenance, and dissemination at the federal and state level are identified. Plans for emergency response in the event of a hazardous material spill are outlined. The U.S. Environmental Protection Agency is the agency responsible for

monitoring the effects of a hazardous material spill on the land, air, water, or biosphere. Existing educational, training and technical programs for personnel involved in hazardous material transportation and spills cleanup are listed. Legislation and regulations concerning the transportation of hazardous materials are reviewed.
W86-00350

[illegible]

8I. Fisheries Engineering

[illegible]

CREEP OF WATER CURED LABORATORY CONCRETES.

[illegible]

10. SCIENTIFIC AND TECHNICAL INFORMATION

10D. Specialized Information Center Services

[illegible]

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VOLUME 19, NUMBER 3
MARCH 1986

GEOLOGICAL SURVEY

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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

VOLUME 19, NUMBER 3
MARCH 1986

W86-00614 -- W86-00919

MARCH 3, 1849

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Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
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Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

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05 WATER QUALITY MANAGEMENT AND PROTECTION

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

MODELING HYDROCLIMATIC PROCESSES IN LARGE WATERSHEDS,
California Univ., Davis. Dept. of Geography.
M. L. Shelton.
Annals of the Association of American Geographers, Vol. 75, No. 2, p 185-202, January, 1985. 5 Fig, 5 Tab, 42 Ref.

Descriptors: *Model studies, *Watershed, *Rainfall-runoff relationships, *Deschutes River Basin, *Oregon, *Hydrologic models, Climatology, Spatial distribution, Simulation.

A spatially disaggregate moisture budget (SDMB) watershed model is presented. The model is designed to simulate the hydrologic response of a large, heterogeneous basin by emphasizing moisture accounting within functionally discrete units in both the horizontal and vertical dimensions. Simulation of the precipitation-runoff process is achieved by dividing the watershed into homogeneous domains or sectors that act independently. Each sector is represented vertically as a four-layer configuration composed of surface, soil root zone, transient groundwater, and perennial groundwater subsystems joined in series. The response of the total watershed is represented by an area-weighted combination of moisture fluxes for each of the separate sectors. Averaging or lumping of model variables achieved through spatial disaggregation of the watershed helps to reduce uncertainty concerning the mangitudes and the spatial and temporal attributes of inputs, outputs, and storages. This conceptual structure permits the model to utilize readily available climatic data, to incorporate a prior knowledge of the physical characteristics of the watershed, and to be adaptable for simulating land use changes. Analysis of spatial and temporal variations in hydroclimatic processes in the Deschutes River Basin in Oregon demonstrates the ability of the model to simulate the transformation of precipitation into runoff in a complex hydrologic setting. (Baker-IVI)
W86-00647

RATE OF BACTERIAL MORTALITY IN AQUATIC ENVIRONMENTS,
Brussels Univ. (Belgium). Lab. d'Oceanographie.
P. Servais, G. Billen, and J. V. Rego.
Applied and Environmental Microbiology, Vol. 49, No. 6, p 1448-1454, June, 1985. 10 Fig, 1 Tab, 32 Ref. Syndicat des Communes de la Banlieue de Paris pour les Eaux contract 30/83 and EEC contract ENV-522-B(RS).

Descriptors: *Bacteria, *Mortality, *Aquatic environment, Radioisotope studies, Tritium, Zooplankton, Grazing, Filtration.

A method is proposed which provides a minimum estimate of the rate of bacterial mortality in growing natural populations of planktonic bacteria. This estimate is given by the rate of decrease of radioactivity from the DNA of a tritiated thymidine-labeled natural assemblage of bacterial after all added thymidine has been exhausted from the medium. Results obtained from river water, estuarine water, and seawater show overall bacterial mortality rates in the range 0.010 to 0.030/h, in good agreement with the range of growth rates measured in the same environments. Use of selective filtration through Nuclepore filters (pore size, 2 mu m) allowed the determination of the contribution of microzooplankton grazing to overall bacterial mortality. Grazing rates estimated by this method ranged from 0 to 0.02/h. (Author's abstract)
W86-00777

FLOWING WATER RESOURCES,
Health Effects Research Lab., Research Triangle Park, NC. Criteria and Special Studies Office.
L. E. Keup.
Water Resources Bulletin, Vol. 21, No. 2, p 291-296, April, 1985. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Water resources, *Streams, *Rivers, Stream order, Stream morphology, Flow discharge, Water management.

Using data related to stream order and the morphological characteristics associated with streams of different discharge rates, an estimate of the river resources of the United States is made. The national totals are: 3,200,000 miles total length of rivers; 15,000 square miles of river surface; and 29 cubic miles of water stored in river channels. Using the same techniques, more exact estimates may be made for individual river basins. Suggestions are given for application of the techniques and river data in the management of water resources. (Author's abstract)
W86-00791

INFLUENCES OF SNOW COVER AND SOIL MOISTURE ON MONTHLY AIR TEMPERATURE,
Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
J. E. Walsh, W. H. Jasperson, and B. Ross.
Monthly Weather Review, Vol. 113, p 756-768, 1985. 15 Fig, 1 Tab, 31 Ref. NSF grant ATM-8313726.

Descriptors: *Snow cover, *Soil water, *Air temperature, Climatology, Precipitation, Model studies, Monthly variation, Seasonal variation.

A series of objective specification experiments were performed with monthly 700 mb heights and surface station temperatures for the United States during 1947-80. The errors in these specifications were used in conjunction with observed snow cover and a computed soil moisture index to assess the impacts of a variable surface state on monthly surface air temperature. Over the eastern and central United States, the mean errors of temperature specifications for the winter months vary by 1-2 C according to the sign of the anomaly of snow cover. Lag results suggest that snow cover can make a modest contribution to the skill of temperature predictions near the snow boundary. The summer specifications were evaluated in terms of a soil moisture index computed from monthly temperatures and precipitation amounts using a modified Thornthwaite/Nappo parameterization scheme. This index varies seasonally in a realistic manner, while the corresponding mean annual runoff is shown to agree well with runoff amounts derived from observed streamflow data. The soil moisture index shows coherent and physically plausible associations with temperature in the central and western United States. In these regions, the mean errors of the temperature specifications vary by approximately 0.5 C according to the sign of the soil moisture anomaly. Impacts of this magnitude are smaller than those obtained in recent general circulation model experiments, but are statistically significant at most stations in the west-central portion of the country.
W86-00860

2B. Precipitation

SEASONAL PRECIPITATION FORECASTING WITH A 6-7 MONTH LEAD TIME IN THE PACIFIC NORTHWEST USING AN INFORMATION THEORETIC MODEL,
Entropy Ltd., Lincoln, MA.
R. A. Christensen, and R. F. Eilbert.
Monthly Weather Review, Vol. 113, No. 4, p 502-518, April, 1985. 6 Fig, 13 Tab, 43 Ref, 2 Append.

Descriptors: *Precipitation, *Forecasting, *Model studies, *Washington, *Oregon, Entropy minimax analysis, Seasonal variation, Prediction, Statistical analysis.

An entropy minimax analysis for the forecast of seasonal precipitation with a 6-7 month lead time was performed for two regions in the Pacific Northwest. A model for the forecast of winter precipitation in the Willamette Valley, Oregon was developed using the 92 year period 1854-1945 for model building. Predictions made for the reserved test years 1946-82 had a 74% accuracy. Statistical test establish a 99% confidence that this success is not due to chance. Models for the forecast of winter and spring precipitation in eastern Washington were developed using the 73 year period 1873-1945. The winter model had 69% predictive accuracy on the test years, with a 97% confidence agains chance. The spring model had an accuracy of 54%, which is statistically indistinguishable from chance. Further analysis reveals that the spring model had an accuracy of 67% for the period 1946-63 and 43% for the period 1964-82, with an 88% confidence against the accuracy decrease arising from chance. This suggests a marginal validity period for the spring model in the order of 15 years following the model building period. The accuracies of the winter model for both western Oregon and eastern Washington show fair uniformity throughout the 37 year test period, with a slight downward trend in the later portion. (Author's abstract)
W86-00778

RAIN ESTIMATION IN EXTRATROPICAL CYCLONES USING GMS IMAGERY,
Bureau of Meteorology, Melbourne (Australia).
R. DelBeato, and S. L. Barrell.
Monthly Weather Review, Vol. 113, p 747-755, May, 1985. 8 Fig, 1 Tab, 14 Ref, 1 Append.

Descriptors: *Rainfall distribution, *Japanese Geostationary Meteorological Satellite, *Remote sensing, *Cyclones, *Australia, Clouds, Blackbody temperature, Satellites, Meteorology, Data interpretation.

A technique was developed which provides estimates of rainfall from extratropical cyclones over an area of 125,000 sq km in southeastern Australia in simulated real time conditions. It utilizes a statistical relation between blackbody temperature of cumuliform cloud and 90 minute rainfall totals to determine estimates of rainfall from cumuliform cloud, and approximates the lesser rainfall amounts from the stratiform pre-frontal cloud as a fixed proportion of rain from equivalent cumuliform cloud. It is based on the digitized 'HR Fax' imagery received at 3 h intervals from the Japanese Geostationary Meteorological Satellite (GMS). Five case studies are presented, each for a 24 hour period. Rainfall estimates for rainfall districts within the area vary from the observed district averages, which were calculated from daily gage data, by an average of 22%. The mean absolute error for districts is 4.2 mm. (Author's abstract)
W86-00859

2C. Snow, Ice, and Frost

SNOWMELT ENERGY BUDGETS IN SOUTHERN AND EAST-CENTRAL WISCONSIN,
San Diego State Univ., CA. Dept. of Geography.
E. Aguado.
Annals of the Association of American Geographers, Vol. 75, No. 2, p 203-211, June, 1985. 6 Fig, 4 Tab, 16 Ref.

Descriptors: *Snowmelt, *Energy budget, *Wisconsin, Solar radiation, Snowpack, Melting, Melt water, Computers, Simulation, Model studies.

Computer simulation has been used to understand the energy balance characteristics of melting covers in the open in southern and east central Wisconsin. The formulation and testing of a descriptive model of snowmelt that relates the phenomenon to previous episodes of accumulation and melt, rather than simply to current meteorological and irradiance conditions, was also explored. Sensible heat flux into the snow was the greatest source of melt energy throughout the 12 years for the majority of days and episodes. Solar irradiation frequently dominated the energy regime, especially when melt occurred late in the season and after large snow accumulations. The effect of prior accumulation and melt on snowpack energetics was discussed and illustrated by the results of the model applied to a year with an unusually deep and long standing snowpack. Snowmelt in Wisconsin occurs throughout a wide range of meteorological and solar irradiance conditions. As the devel-

opment of temperature index models is dependent on the assumption that the relative importance of turbulent and radiative fluxes is nearly invariant, it is unlikely that simple predictive equations are going to be formulated. Such models must include the time of year and the responsiveness of the snow to the various heat inputs. (Baker-IVI)
W86-00648

ESTIMATING REGIONAL SNOW WATER EQUIVALENT WITH A SIMPLE SIMULATION MODEL,

Pacific Southwest Forest and Range Experiment Station, Berkeley, CA.
R. C. Kattelmann, N. H. Berg, and M. K. Pack.
Water Resources Bulletin, Vol. 21, No. 2, p 273-280, April, 1985. 5 Fig, 1 Tab, 20 Ref.

Descriptors: *Snowpack, *Simulation, *Computer models, Model studies, Water equivalent, Precipitation, Air temperature, Snowmelt, Rainfall, Snow cover.

A simple water balance approach is applied to snowpack in this simulation model. Solid precipitation increases snowpack water equivalent as does rain in amount less than the water holding capacity. Rain in excess of the retention capability drains through the pack without adding to the water equivalent. Melting reduces the water equivalent when the pack is saturated with liquid water. The model estimates average snow water equivalent for rectangular subregions in the area. A snowpack water balance is maintained for each subregion on the basis of the average meteorological conditions calculated for the particular subregion. Static subregion characteristics, daily precipitation and mean and minimum air temperatures measured at three index stations are the only needed input values. The model was developed empirically, and each component represents an average condition within the ranges of different meteorological events. Unusual events at the extremes of these ranges may be poorly simulated. The model appears to perform well as indicated by comparison with point measurements of snowpack water equivalent. The mode has a relatively short computer program and run-time, and produces easily interpretable output. (Moore-IVI)
W86-00789

2E. Streamflow and Runoff

STOCHASTIC FLOOD ANALYSIS IN A REGION OF MIXED GENERATING PROCESSES,

Saskatchewan Univ., Saskatoon. Dept. of Geography.
P. R. Waylen.
Transactions of the Institute of British Geography, Vol. 10, No. 1, p 95-108, 1985. 14 Fig, 2 Tab, 22 Ref.

Descriptors: *Stochastic hydrology, *Flood analysis, *British Columbia, Spatial distribution, Flood control, Floods, Streamflow, Snowmelt, Rainfall.

Partial series were obtained from streamflow records of seventeen drainage basins located in southwestern British Columbia. The selection of partial series as a method for analyzing the flood hydrology of a region provides a readily applicable technique which maximizes the use of sample data and provides additional valuable information concerning the frequency and timing of floods. The method is sufficiently flexible that it may be used in a variety of physical environments to provide a satisfactory statistical fit and yet remain physically interpretable. Basins experiencing snowmelt, rainfall and mixed process generated floods are successfuly analyzed in areas receiving between 300 and 3000 mm of annual precipitation. The choice of probability distributions is theoretically based, parameters are estimated easily and permit spatial comparison. The changing values of parameter estimates are strongly linked to the regional flood generating processes. A great deal of their observed spatial variability is explained by changes in the frequency domain of such events rather than their magnitude and timing. In light of these observations a regional approach and extrapolation of process based parameter estimates to basins of interest may be an alternative method of dealing with unusual outliers in flood series. Present engineering practice is to either interpolate between empirical plotting positions or to selectively discard such events. Both techniques lead to poor flood frequency estimates and the loss of valuable regional hydrologic information. Partial series provide the basis of the analysis of annual floods and daily maxima and should be considered as a potential method of analyzing other hydrometeorological extremes. (Baker-IVI)
W86-00646

SNOWMELT ENERGY BUDGETS IN SOUTHERN AND EAST-CENTRAL WISCONSIN,

San Diego State Univ., CA. Dept. of Geography.
For primary bibliographic entry see Field 2C.
W86-00648

STORM WATER RUNOFF FROM INDUSTRIAL SITES,

Baxter and Woodman, Inc., Crystal Lake, IL.
For primary bibliographic entry see Field 5B.
W86-00766

APPLICATION OF SIMPLE MOISTURE ACCOUNTING MODELS TO UNGAUGED CATCHMENTS,

Severn-Trent Water Authority (England).
J. Pirt, and E. A. Bramley.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 169-177, April, 1985. 5 Fig, 5 Tab, 6 Ref.

Descriptors: *Runoff, *Mathematical models, *Moisture accounting models, Geology, Morphology, Flow forecasting, Simulation, Design flow, Baseflow, Channel routing, Hydrological models, Model studies, England.

Adaptation of a simple, isolated events model (IEM4) to ungauged areas, using catchment geology and morphology to estimate model parameters, produced encouraging estimates of model parameters for design flow prediction, real-time flow forecasting, and flow simulation. The model involves eight parameters: 'groundwater reservoir factor' controlling the rate of baseflow, 'channel routing factor' controlling the effect of channel size on hydrograph shape, 'time delay before hydrograph rise', 'duration of hydrography response', 'runoff percentage at zero soil moisture deficit (SMD)', 'decay rate of run-off percentage/SMD function', 'maximum runoff percentage' under saturated soil conditions, and 'maximum percolation rate' to groundwater under saturated soil conditions. Accuracy and reliability of the model and parameter estimation equations were tested on four catchments in England which differed in geology and topography and ranged in size from 50-165 sq km. Flow forecasts were made for three events in each catchment in pseudo real time. The results in Kingston Brook to Kingston and the River Dove to Kirkby Mills had average errors of estimated peak flows and total runoff volumes of 2.5% and 6.6%, respectively. Timings of the peak flows were also accurate. For the Ecclesbourne and Rother catchments, there were noticeable discrepancies in hydrograph shape and volume, but major errors were restricted to only two events, in which hydrograph peak, total volume, and timing were all in error. (Rochester-IVI)
W86-00836

ALLUVIAL FANS: NOVEL FLOOD CHALLENGE,

Riverside County Flood Control and Water Conservation District, CA.
K. L. Edwards, and J. Thielmann.
Civil Engineering, Vol 54, No. 11, p 66-68, November, 1984. 2 Fig.

Descriptors: *Alluvial fans, *Flood plain management, *Carbozon, *California, Land use, Zoning, Flood protection.

Theoretical considerations, combined with information derived from prior flood events, were used to develop a flood management plan for Carbozon, California, which had been severely damaged by flooding. There had been six major floods in Riverside County within the preceding 5 yr when the study was undertaken. In the upstream reaches of the study area, steep slopes of 2-3%, coupled with the erodible alluvial bed material, produce severe and erratic lateral and vertical erosion in the river channel, which may change its course dramatically during floods. The Dawdy method of predicting channel geometry was used with the modification that Manning's equation was substituted for critical depth. The revised method predicted velocities of 10-25 ft/sec, channel depths of 1-3 ft, and channel widths of 100-500 ft in the 100-yr flood. These figures agreed reasonably well with field measurements of recent alluvial floods in the area. In order to allow for flood flow, minimum lot sizes on the alluvial fans in Carbazon were specified at one-third acre and one-half for two of the fans, and 30-35% of each lot had to remain open to pass floodwaters. In areas of Carbazon where flow velocities of 15 ft/sec or higher were expected, no development was recommended; some development would be permitted in areas of lower predicted velocities, but subject to strict floodproofing and development density limits. (Rochester-IVI)
W86-00885

2F. Groundwater

SEISMIC MICROACTIVITY AND WATER LEVEL VARIATION IN INDUSTRIAL AREA NEAR FLORENCE (ITALY),

Florence Univ. (Italy). Ist. di Geologia e Paleontologia.
G. Gabbani.
Bollettino della Societa Geologica Italiana, Vol. 103, No. 1, p 87-95, 1984. 9 Fig, 17 Ref.

Descriptors: *Florence, *Italy, *Seismology, *Groundwater withdrawals, Water level, Industrial development, Geological fractures.

Analysis of seismic microevents close to the Prato Seismological Station (Florence, Italy) showed a puzzling regularity: the seismicity was practically absent during the night and holidays, while it increased during the working hours, reaching a peak in the late afternoon and then sharply declining. Through the use of a portable seismometer it was possible to ascertain with reasonable confidence that the origin of the microseismicity is located under the industrial settlement of Montemurlo. This particular settlement has grown in the last 20 years. Microevents recorded with magnitudes of 1.6-1.9 and distances of about 7.0 km were selected and their daily and weekly distributions were compared with corresponding trends of the groundwater withdrawal due to the industrial activities. Fluctuations of the ground water level paralleled the occurrence of microseismicity. Withdrawals may induce displacements in existing faults or fractures. (Baker-IVI)
W86-00632

SECURITY OF GROUNDWATER CATCHMENTS NEAR RIVERS; CHARTS TO DETERMINE THE VARIATION IN THE REPLENISHMENT FLOW (SURETE DES CAPTAGES D'EAU SOUTERRAINE A PROXIMITE DES RIVIERES; ABAQUES POUR DETERMINER L'EVOLUTION DU DEBIT DE REALIMENTATION FLOW),

Laboratoire National d'Hydraulique, Chatou (France).
J. P. Bouchard.
Houille Blanche, No. 1, p 53-71, 1985. 9 Ref, 13 Fig.

Descriptors: *Groundwater recharge, *Water table, *Water quality control, Aquifers, Pumping, Boreholes, Computers, Rivers, Water pollution control, Hydrodynamics.

The security of catchments of ground water in an alluvial water table as regards the pollution of the river requires being able to predict the transient changes in the flowrates and volumes of river water drawn to the borehole when pumping is

stopped. These values were determined by a computer program for different cases and are shown on charts. The parameters taken into account are the hydrodynamic characteristics of the water table, the flowrate and geometry of pumping, the lateral replenishment of the water table and possible obstruction of the riverbed. (Author's abstract)
W86-00656

EFFECT OF GROUNDWATER ON SOIL FORMATION IN A MORAINAL LANDSCAPE IN SASKATCHEWAN,

Saskatchewan Univ., Saskatoon. Saskatchewan Inst. of Pedology.
J. J. Miller, D. F. Acton, and R. J. St. Arnaud.
Canadian Journal of Soil Science, Vol. 65, No. 2, p 293-307, May, 1985. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Groundwater, *Moraines, *Saskatchewan, *Soil genesis, Water table, Recharge, Discharge, Soluble salts, Morphology, Carbonates, Leaching.

Soils in a given landscape position in the study area exhibit similar morphological and chemical characteristics, the genesis of which can be related to soil moisture regimes and groundwater flow. Based on study results, it is possible to predict the hydrological characteristics of a soil from its landscape position, morphology, and classification. Non-saline, non-carbonated Humic Luvic Gleysols occurring in upland depressions are associated with groundwater recharge. Water tables are close to or above the soil surface following spring snowmelt runoff. The infiltration of this water forms groundwater mounds under the depression, which decline gradually over the summer due to recharge and lateral dissipation. Leaching, as indicated by solum depth, is variable between and within the sloughs, and can be related to slough size, shedding area available for surface runoff, and to location within the larger depressions. Soils at locally low elevations include nonsaline and saline soils. Non-saline soils are found in depressions which receive snowmelt runoff in the spring, and consequently are leached of salts. Saline soils occur on lower slope positions, where the water table is always within 2-4 m from the surface, and often within 2 m, enabling the capillary fringe to deposit carbonates and soluble salts close to the surface, through evaporation. Saturated flow may include recharge, discharge, or lateral flow. A wide range in soils occurs on cultivated uplands. Soils on convex slopes are generally shallow and associated with a deep water table and mainly recharge and lateral groundwater flow. Differences in the genesis of these soils result from the degree of slope-influenced moisture redistribution rather than from slope dictated infiltration. Soils on concave slopes can be related to a high water table and/or possibly saturation above frozen subsoil in the spring. (Baker-IVI)
W86-00670

STEP-DRAWDOWN AND CONSTANT-RATE PUMPING TESTS,

D. L. Goodrich.
Waterwell Journal, Vol. 39, No. 5, p 39-42, May, 1985. 1 Tab.

Descriptors: *Step-drawdown tests, *Constant-rate pumping tests, *Pumping tests, *Aquifers, Groundwater, Wells, Pumps, Well yield, Unconsolidated aquifers.

Step-drawdown tests are used to ascertain the present performance of an aquifer, the well, and the pump. Such tests are commonly used to check on the performance of new or established wells completed in unconsolidated aquifers. Specific instructions for conducting step-drawdown and constant-rate pumping tests are given, including set-up, equipment, and management during the tests. The results of a step-drawdown test are used to calculate approximate aquifer parameters, the extent of development of a new well, well efficiency, and the operating condition of the pump. The well to be tested should be taken out of service at least 24 hr prior to the test to establish a representative static water level. When testing, discharge should be monitored for sand and entrained air. Constant-rate pumping tests are used to evaluate the yield capacity of an aquifer during extended periods of continuous pumping, usually for a minimum of 3 days. The pumping rate selected must be one that the aquifer, the well, and the pump are capable of maintaining. When properly performed, the test can ascertain the existence of aquifer recharge boundaries and barrier boundaries, and can provide information on the magnitudes of transmissivity and storativity, the two most important aquifer parameters. The tests can also be used to calculate the well's radius of influence. A base-line well should be located at least 1 mile from the pumping well in an unconfined aquifer and at least 2 miles away in a confined aquifer. The test is conducted ideally when ground water levels are at their seasonal low - in late September or October. Steps must be taken to ensure that discharged water does not flood nearby areas or infiltrate back into the aquifer. (Rochester-IVI)
W86-00712

HYDROGEOLOGICAL PROSPECTING GROUP AND TYPES OF MINERAL DEPOSITS FILLED WITH KARST WATER IN CHINA (IN CHINESE).

Acta Geologica Sinica, Vol. 58, No. 2, p 152-164, 1984. 7 Tab, 9 Ref.

Descriptors: *Geohydrology, *Karst, *Minerals, *China (Peoples Republic), Groundwater, Aquifers, Geological fractures, Karst hydrology, Altitude, Caverns, Groundwater level.

It is suggested in this article that the form of potential space filled with water in the karst aquifers is a very important factor to be considered in the classification of hydrogeological prospecting groups of mineral deposits filled with karst water in China. Difference in such spatial forms has relevant effects on the conditions of storage and flowage of the ground water concerned and hence also has great influence on the methods of hydrogeological prospecting and evaluation. The mineral deposits filled with karst water in China may thus be classified into three groups, i.e., mineral deposits filled mainly with karst water in corroded fissures, those in caverns and in ground-rivers, and those in karst passageways. The distribution, hydrogeological features and prospecting perculiarities of each one are duly described. The 'contact' relation, or rather, spatial relation, between the mineral deposits, whether mineral beds or ore bodies, and the rocks or rock formations filled with water also direct influence on the conditions of flow of the karst water into the open pits or underground mines and measures of its prevention. Hence it is an important factor governing the planning of hydrogeological prospecting, including concrete methods, amount of prospecting works, etc. Four types of the mineral deposits in question may be further subdivided on such a basis, viz., mineral deposits with the water-filling rock (rock formation), or karst aquifer, as the direct roof of the mineral beds or ore bodies, with those as the direct floor, with those in the roof but not in direct contact, and with those in the floor but not in direct contact. Among the factors to be taken into consideration in the concrete hydrogeological prospecting are the altitudinal relationships of the mineral deposits and the local base level (of erosion) as well as the ground water level, influence of the surface water, the area of water-filling rock formations (or the catchment area in the case of ground-river and passageway water), degree of development of faulting and fissuring and the conditions of karst collapses in the case of cavern water. The aforesaid groups or types may be divided into simple, intermediate and complex categories so far as the combined effects of these factors are considered. (Author's abstract)
W86-00897

FOSSIL WATER UNDER THE SINAI-NEGEV PENINSULA,

A. Issar.
Scientific American, Vol. 253, No. 1, p 104-110, July, 1985. 7 Fig.

Descriptors: *Aquifers, *Fossil water, *Sinai Desert, *Egypt, *Negev Desert, *Israel, Isotope studies, Springs, Wells. Water resources development, Geology, Geohydrology.

A study of water issuing from springs and wells scattered across the Sinai (Egypt) and the Negev (Israel) deserts has identified a great aquifer formed during the last glacial age. Satellite photographs of the region reveal surface characteristics consistent with subterranean geology that could support an aquifer. Carbon-14 dating puts the age of the water from springs and wells at 20,000 to 30,000 yr. The ages determined from C-14 dating agree with results of hydrological flow models. Water samples from the 'Ayun Musa, from the abandoned oil-exploration well dug into the Nubian sandstone layer in Nakhel and from the artesian wells in the Nubian sandstone layer near the Dead Sea all have the same relative amounts of deuterium and oxygen-18. The chemical and isotopic studies in conjunction with archaeological evidence suggest that the aquifer holds rainwater that was trapped during the most recent ice age. It has been calculated that the Nubian sandstone aquifer under the Sinai and the Negev holds 200 billion cu m of water, 70 billion cu m of which is under the Negev. Agricultural settlements in the Negev demonstrate that the water is low enough in salt content to be suitable for irrigation. (Moore-IVI)
W86-00911

2G. Water In Soils

DETERMINATION OF MOISTURE IN SOLIDS,

Lawrence Livermore National Lab., CA.
J. W. Pyper.
Analytic Chimica Acta, Vol. 170, No. 2, p 159-175, April 1985. 2 Fig, 91 Ref. U.S. DOE contract W-7405-Eng-48.

Descriptors: *Soil water, *Bound moisture, *Free moisture, Sampling, Measuring instruments, Dynamic dielectric thermal analysis, Coherent microwave measurements, Infrared spectrometry, Near-infrared reflectance spectrometry, Thermal methods, Nuclear magnetic resonance spectrometry.

The scientific literature published since Pande's comprehensive monograph Handbook of Moisture Determination and Control (1974) was surveyed (to mid-1984) for new or improved techniques of determining moisture in solids. Particular attention is given to methods that might distinguish between bound and free moisture in organic solids. The classification of moisture is discussed, as well as pitfalls in sampling, in sample handling, and in the comparison of different methods. Six methods that show promise of being able to distinguish between bound and free moisture were identified: dynamic dielectric thermal analysis, coherent microwave measurements, infrared spectrometry, near-infrared reflectance spectrometry, thermal methods and nuclear magnetic resonance spectrometry. (Author's abstract)
W86-00644

SURFACE SOIL WATER CONTENT MEASUREMENT USING PULSED NUCLEAR MAGNETIC RESONANCE TECHNIQUES,

Agricultural Research Service, Beltsville, MD. Hydrology Lab.
R. F. Paetzold, G. A. Matzkanin, and A. De Los Santos.
Soil Science Society of America Journal, Vol. 49, No. 3, p 537-540, May-June, 1985. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Soil water, *Nuclear magnetic resonance, *Ground truth data, *Measuring instruments, Moisture probe, Soil type, Gravimetric water content.

A tractor-mounted nuclear magnetic resonance (NMR) soil moisture measurement instrument was developed and tested, demonstrating a high correlation between NMR output and volumetric and gravimetric soil moisture. This device may be used for obtaining ground truth data for calibrating and evaluating remotely sensed determinations. NMR

techniques can selectively measure only the hydrogen associated with water. The prototype instrument is composed of two major units, a sensor and an electronics package. The NMR sensor contains the electromagnet, the detection coil, and the tuning capacitor. The electronics package consists of the radio-frequency subsystem, the control and signal-processing subsystem, and the power distribution subsystems; the package is mounted on a 63 horsepower diesel tractor, along with a diesel generator that provides electrical power to the instrument. The sensor assembly has a mass of about 300 kg, and is mounted on the tractor's three-point hitch. Power is supplied to the magnet through the electronics package. About 300 watts are required to create a 55.7 kA/m field at 5 cm. A keyboard-type control console with a thermal printer is mounted inside the tractor cab. Measurement depths of 38, 51, or 63 mm can be selected here. Results are printed automatically, and additional notes can be typed with the output. Stationary measurements on a clay and loamy fine sand in buckets, yielded a linear relationship (r=0.98 at 38 mm, r=0.99 at 51 mm) between NMR signal and volumetric soil water content over the range 5-30% water by weight. Similarly, the gravimetric water content also showed a linear relationship with NMR values (r=0.93 at 38 cm, r=0.96 at 51 cm). In field tests in a clay loam and a gravelly sandy loam, gravimetric water content and NMR signal showed a linear correlation (r=0.92). Results with a stationary instrument or one moving at 26 cm/sec did not differ. Maintaining contact between the sensor and the soil surface was difficult in the clay loam soil. (Rochester-IVI)
W86-00698

SOLUTE DISPERSION DURING AXISYMMETRIC THREE-DIMENSIONAL UNSATURATED WATER FLOW,

Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
B. E. Clothier, and D. E. Elrick.
Soil Science Society of America Journal, Vol. 49, No. 3, p 552-556, May-June, 1985. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Solute transport, *Dispersion, *Unsaturated flow, Mathematical studies, Infiltration, Hydrodynamics, Convection, Wetting, Soil water, Bromides.

An approximate, analytic solution is presented for the smearing of solute by both convection and dispersion during axisymmetric three-dimensional constant flux infiltration from a surface point source in unsaturated soil. The steady-state pattern of axisymmetric streamlines is used to track individual parcels of water as they move away from the surface emitter. A simple analytic expression is developed to describe the time course of the hydrodynamic dispersion of solute about the convected front as it moves along any given streamline. The location of the convected front at any time is predicted from the profile of wetting along that streamline. The plane-of-separation concept is used to find the distance travelled by the convected front along the streamline. The invading solution is considered to act as if to effectively piston-displace the antecedent soil water. Profiles of bromide concentration along three streamline paths were measured during constant-flux point-source infiltration experiments in the laboratory with fine sand. These measurements compared favorably with the theoretical predictions. (Author's abstract)
W86-00700

SOLUTE DISCHARGE DURING STEADY WATER DRAINAGE FROM A SAND TANK,

Florida Univ., Gainesville. Dept. of Plant Pathology.
R. S. Mansell, P. J. McKenna, and M. E. Hall.
Soil Science Society of America Journal, Vol. 49, No. 3, p 556-562, May-June, 1985. 10 Fig, 2 Tab, 12 Ref.

Descriptors: *Drainage, *Solute transport, Simulation, Mathematical models, Saturated flow, Infiltration, Soil water, Boundary conditions, Breakthrough curve.

An alternating direction implicit (ADI) numerical method was used to simulate transient solute movement resulting from a step-function increase of solute concentration in water applied to a shallow sand tank system with a subsurface drain. Steady water flow in the saturated portion of the tank was simulated using an iterative alternating direction implicit (IADI) numerical method. The saturated-unsaturated condition in the actual sand tank was approximated by a smaller rectangular flow region of saturation in the model simulation. Isopleths of hydraulic head and solute concentration within the soil demonstrated a decrease in the rate of infiltration from the point vertically above the drain to the point vertically above the midpoint between the drains. Consequently, solute transport was much faster in the surface soil overlying the drain than in the soil near the mid-point between drains. When cumulative effluent volume was expressed as the number of pore volumes, breakthrough curves for solute concentration in the drainage water revealed early arrival of solute compared to a one-dimensional system. In spite of the different boundary conditions imposed at the soil surface in the tank and in the model, reasonable agreement was obtained between simulated breakthrough curves and experimental data from the sand tank. (Author's abstract)
W86-00701

MONTE-CARLO SIMULATION OF NONINTERACTING SOLUTE TRANSPORT IN A SPATIALLY HETEROGENEOUS SOIL,

Texas A and M Univ., College Station.
N. Persaud, J. V. Giraldez, and A. C. Chang.
Soil Science Society of America Journal, Vol. 49, No. 3, p 562-568, May-June, 1985. 5 Fig, 6 Tab, 26 Ref.

Descriptors: *Monte-Carlo process, *Simulation, *Solute transport, *Soil water, dispersion, Interstitial water, Velocity, Differential equations, Percolation.

Monte-Carlo data generation techniques were used to obtain 200 pairs multivariate lognormal values of the physical parameters D (dispersion coefficient) and v (pore-fluid velocity) which appear in the differential equation describing downward leaching of a noninteracting solute in the soil profile under steady-state percolation. The time (tmax), at which the maximum concentration is attained at given soil depth L after a pulse input of solute has been applied at the soil surface for a time t0, was obtained for each pair of generated D and v values. Values of the ratio delta L/delta tmax representing the average rate of movement of the maximum concentration between two depths were also calculated. The effect of changes in the variance of v and the levels of correlation between D and v on the frequency distribution of tmax-t0 was investigated. The lognormal and gamma distributions were fitted to the calculated distributions of tmax-t0. Good fits were obtained with both theoretical distributions to the values of tmax-t0. The lognormal distribution was better in describing the values of delta L/delta tmax. The parameters and properties of these calculated distributions were sensitive to changes in the variance of v but were less sensitive to changes in the correlation between D and v. The ensemble average of 200 concentration versus time curves was computed by substituting the generated parameters D and v in the solution to the differential equation. This curve was compared to that obtained using the sample mean values of D and v. The dissimilarity between these curves was sensitive to changes in the variance of v. (Author's abstract)
W86-00702

SEEPAGE-LIMITATION OPTIMIZATION OF THE SHAPE OF AN IRRIGATION CHANNEL BY THE INVERSE BOUNDARY-VALUE PROBLEM METHOD,

For primary bibliographic entry see Field 3F.
W86-00869

2H. Lakes

COMPARISON OF THE PHOSPHORUS-CHLOROPHYLL RELATIONSHIPS IN MIXED AND STRATIFIED LAKES,

Alberta Univ., Edmonton. Dept. of Zoology.
E. T. Riley, and E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 831-835, April, 1985. 2 Fig, 1 Tab, 19 Ref.

Descriptors: *Phosphorus, *Chlorophyll, *Mixed lakes, *Stratified lakes, Chlorophyll a, Thermal stratification, Nutrients.

Data from the literature were used to calculate separate regressions of summer chlorophyll a concentration (Chl a) on spring total phosphorus concentration (TP) for lakes that remain thermally stratified during the summer and lakes that mix intermittently during the summer. Significant differences were found in the spring (TP)-summer (Chl a) relationships for the two lake types ($P < 0.05$). The mean ratios of summer (TP) to spring (TP) were also significantly different in stratified and mixed lakes ($P < 0.001$); this difference is the explanation offered for why the spring (TP)-summer (Chl a) relationships were different in stratified and mixed lakes. (Author's abstract)
W86-00614

DISTRIBUTION PATTERN OF DENITRIFYING BACTERIA IN FISH PONDS OF DIFFERING FARMING MANAGEMENTS,

Kalyani Univ. (India). Dept. of Zoology.
B. B. Jana, and G. N. Patel.
Archiv fur Hydrobiologia, Vol. 3, p 291-303, May, 1985. 6 Fig, 4 Tab, 18 Ref.

Descriptors: *Denitrification, *Bacteria, *Fish ponds, Fish management, Fisheries, Fish farming, Nutrients, Organic carbon, Nitrogen, Phosphates, Population dynamics.

The population size of denitrifying bacteria was measured in fish ponds of differing fish farming management practices. Due to different stocking combinations and rearing practices, it was hypothesized that there would be a difference in the population structure of denitrifying bacteria among the ponds used for monoculture, polyculture and traditional systems. Environmental factors responsible for the seasonal variations of denitrifying bacteria in these ponds were identified. Maximum population in monoculture and lowest in traditional types were related to their enrichment properties in terms of organic carbon, inorganic nitrogen and phosphate. Seasonally, bacterial populations peaked in the summer and were reduced in the winter; harmonic analysis of empirical function with 12 ordinates was the best model to predict the annual cycle of DNB in all fish ponds. Stepwise multiple regression analysis between the log values of monthly numbers of bacteria occurring in the fish ponds and the environmental factors revealed that organic C, inorganic N, water temperature and phosphate were perhaps important attributes causing seasonal changes of DNB in these fish ponds. (Baker-IVI)
W86-00622

EVALUATION BY FIELD EXPERIMENTS OF THE MCLAY MODEL OF STREAM DRIFT,

British Columbia Univ., Vancouver. Inst. of Animal Resource Ecology.
P. A. Larkin, and D. W. McKone.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 5, p 909-918, May, 1985. 7 Fig, 6 Tab, 13 Ref.

Descriptors: *Drift, *Mathematical models, *Stream biota, *McLay model, Velocity, Stream flow, Migration, Sampling.

The model of McLay (J. Fish. Res. Board Can. 27:359-370) for describing the drift of stream organisms was tested in a variety of field experiments in which organisms were disturbed from the substrate and/or the natural drift was blocked. In each situa-

tion, appropriate corrections may be made of the catch of drift organisms by the sampling nets. Disturbed animals drifted at a rate much less than stream velocity. The logarithm of the distance travelled was a linear function of the logarithm of mean stream velocity and conformed to the McLay model. Similarly, the model adequately described experiments in which two disturbances were done simultaneously, when drift was blocked for a 2-h period, and when there was both disturbance and blockage. A more comprehensive version of the model was only partially successful in describing the drift at various distances downstream of a blockage sustained for 4 d, probably because of upstream migration of organisms through the substrate, spatial differences in the densities of animals in the substrate, or a reduction in drift rate at lower density in the substrate. (Author's abstract)
W86-00628

CHECKLIST OF PHYTOPLANKTON (EXCLUSIVE OF DIATOMS) IN KENTUCKY RESERVOIR,

Murray State Univ., KY. Dept. of Biological Sciences.
L. E. Barnese, and J. M. King.
Transactions of the Kentucky Academy of Science, Vol. 46, No. 1/2, p 46-50, March, 1985. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Phytoplankton, *Kentucky Reservoir, *Tennessee River, *Population dynamics, Algae, Seasonal variation.

An attempt was made to identify the phytoplankton species which occur in the lower portion of Kentucky Reservoir. Fourteen collection sites were established between the Tennessee River miles 43.3 and 49,.0 on Kentucky Reservoir. Two sites were located in each of 2 embayments on the western and eastern sides of the reservoir. Six sites were established in the main portion of the reservoir and were situated upriver, between and downriver from the embayments. The study revealed 156 species, varieties and forms representing 59 genera. The green algae dominated the algal flora in all seasons but were most numerous in summer, blue-green algae were most abundant in summer and fall, while euglenoids reached their peak in summer. The number of dinoflagellates was relatively low throughout the year. (Baker-IVI)
W86-00631

BIOLIMNOLOGY OF HARVEYS LAKE,

Wilkes Coll., Wilkes-Barre, PA. Dept. of Biology.
B. B. Smith, and C. B. Reif.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 2, p 131-139, 1984. 3 Tab, 31 Ref.

Descriptors: *Harveys Lake, *Pennsylvania, *Biolimnology, *Plankton, Algae, Copepods, Cladocerans, Rotifers, Zooplankton, Phytoplankton, Population dynamics, Diatoms, Cyanophyta, Chlorophyta, Pyrrhophyta.

The algae of Harveys Lake have been studied very little for a lake of its age and size. It is the largest natural lake in Pennsylvania, with an area of 263 hectares. As a dimictic lake, Harveys Lake is well-stratified during the summer periods. Oxygen concentration in the hypolimnion was 4 ppm just under the thermocline and less than 1 ppm in the deepest part of the lake. Oxygen concentration under the ice was reduced to less than 3 ppm just before the spring breakup. Mean pH values show a downward trend from 7.4 to 6.2 during the last three decades. The lake demonstrated the annual seasonal algal successional pattern typical of temperate dimictic lakes: diatom dominance in winter, chlorophyte abundance in summer and autumn, and blue-green maxima in late summer. Diatoms were present throughout the year, with lowest numbers in summer months. Two blue-green organisms, variously identified as Anabaena sp. and/or Nostoc sp., were present throughout the year, in greater numbers in the summer months but rare in the winter. In other algal groups, Peridinium bloomed in June and Dinobryon was present throughout the year with peaks in March, May, and August. Euglenoids were rare, as was Mallomonas. The zooplankton community appeared to be typical of a lake population and consisted of different species in limnetic and littoral zones. Very few copepods were in the tows or in the squeezes during 1982-83, compared with the numbers observed in samples from Harveys Lake collected in previous years. Cladocerans and rotifers were most abundant with Bosmina and Chydorus present in all samples. (Baker-IVI)
W86-00633

ADDITIONS TO ICHTHYOFAUNA OF THE SUSQUEHANNA RIVER WITH A CHECKLIST OF FISHES OF THE SUSQUEHANNA RIVER DRAINAGE BELOW CONOWINGO DAM,

Radiation Management Corp., Drumore, PA. Muddy Run Ecological Lab.
P. E. McKeown.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 2, p 187-192, 1984. 1 Fig, 1 Tab, 24 Ref.

Descriptors: *Conowingo Dam, *Maryland, *Susquehanna River, *Fish, Population dynamics, Hydroelectric plant, Migration, Distribution.

Conowingo Dam (Maryland) presently acts as an effective barrier to the upstream migration of fishes. Access to the upper Susquehanna River is limited to the transport of select species from the fish collection facility at the Dam. Accessibility of the lower Susquehanna River to upriver migration from the bay region, migration to and from Deer and Octoraro creeks and downriver passage through Conowingo Dam provide a theatre for a diverse fishery. A total of 103 species was recorded for the Susquehanna River Drainage in compiling the ichthyfaunal list. Seventy-two of these fishes are considered native to the River drainage. Of the total number recorded for the drainage, 78 were collected in the lower Susquehanna River during the study period. Fourteen are considered additions to the drainage and were not previously discovered there. (Baker-IVI)
W86-00635

FACTORS CONTROLLING MASS LOSS AND NITROGEN DYNAMICS OF PLANT LITTER DECAYING IN NORTHERN STREAMS,

Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2K.
W86-00637

ALTERATION OF MICROBIAL METABOLIC ACTIVITIES IN ASSOCIATION WITH DETRITUS,

North Carolina Univ. at Morehead City. Inst. of Marine Sciences.
For primary bibliographic entry see Field 2K.
W86-00639

ACCUMULATION OF SEDIMENT ORGANIC MATTER IN A HARDWATER LAKE WITH REFERENCE TO LAKE ONTOGENY,

University of Southern Mississippi, Hattiesburg. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2J.
W86-00643

FRESHWATER AQUACULTURE IN CHINA: ECOSYSTEM MANAGEMENT FOR SURVIVAL,

New Alchemy Inst., East Falmouth, MA.
R. D. Zweig.
Ambio, Vol. 14, No. 2, p 66-74, 1985. 10 Fig, 1 Tab, 26 Ref.

Descriptors: *Fisheries, *China (Peoples Republic), *Aquaculture, Ecosystems, Management, Water resources development, Fish ponds.

The demand for freshwater fish is high in China. The enormous population pressure upon available natural resources in general is perhaps the greatest present environmental concern. The long history of freshwater aquaculture development demonstrates how China's overall food production strategies have come to use intensely her inherent water resources, including ponds, natural lakes and reservoirs. Nonetheless, considerable room exists for expansion of, and improvement in, the overall efficiency of fisheries practices. Various approaches are suggested for lake fisheries, reservoir fisheries and pond fish culture. The matching of feeding habits of fish polyculture to the available nutrients is an important step. There are two pond-fish culture strategies which are most commonly followed in China - stocking and harvesting in rotation and multigrade conveyor culture. With the rotation method, three size classes of each species are stocked in food-fish ponds during February and March. Beginning in July and August and continuing through January, the harvest sized fish are seined from the pond and replaced with fingerlings. The multigrade conveyor method uses a series of ponds with fishes of specific size classes cultured in each pond and moved as they grow. From the last pond, generally the fifth in the sequence, market sized fish are harvested monthy. The latter method is most common in the south of China where year-round, high growth is possible. (Baker-IVI)
W86-00664

RELATIONS BETWEEN PHYTOPLANKTON AND ENVIRONMENTAL FACTORS IN A SMALL, SPRING-MEROMICTIC LAKE IN SOUTHERN FINLAND,

Helsinki Univ., Lammi (Finland). Lammi Biological Station.
L. Arvola, and M. Rask.
Aqua Fennica, Vol. 14, No. 2, p 129-138, 1984. 11 Fig, 1 Tab, 40 Ref.

Descriptors: *Phytoplankton, *Meromictic lakes, *Finland, Lakes, Temperature effects, Seasonal variation, Primary productivity, Zooplankton, Plankton, Nutrients, Stratification, Light intensity, Chlorophyll.

Factors controlling the phytoplankton community in the epilimnion of a steeply stratified lake with restricted turbulence mixing are demonstrated. The study lake, Alinen Mustajarvi, is a small oligomesohumic lake situated in the Evo district in southern Finland. The lake is a groundwater seepage lake, having no inlets and with a very small catchment area. Before ice break, chlorophyll a concentration increased as well as the proportion of small flagellates. A slight maximum of chlorophyll was noted about 2 weeks after the ice break. At the beginning of the thermal stratification algal succession was very rapid. Small Chlorococcales dominated in midsummer, chrysophytes later in summer and in autumn as well as cryptomonads and dinophytes. Generally, smaller species dominated in spring and during summer stratification and larger ones later in summer and in autumn. Factors determining the phytoplankton community seemed to be as follows: before ice break mainly light and temperature, after ice break temperature and nutrients, during summer stratification nutrients and zooplankton grazing, in autumn temperature and nutrients and during the autumn turnover light and temperature. The productivity of the study lake was rather high compared to the other Scandinavian lakes with small surface area and similar physicochemical conditions. Water color was one reason for this because in the study lake the euphotic zone was much deeper than in more colored brown water lakes. (Baker-IVI)
W86-00672

GENERAL LAKE WATER QUALITY INDEX,

National Board of Waters, Helsinki (Finland). Water Research Inst.
V. Malin.
Aqua Fennica, Vol. 14, No. 2, p 139-145, 1984, 7 Fig, 14 Ref.

Descriptors: *Lakes, *Water quality, *Pollution index, Measurement, Cluster analysis, Regression analysis.

A general lake water quality index was sought on the basis of data secured from a network of deep-water lakes during the years 1976-1981. By using

the principal component- and cluster analysis techniques, the variables to be included in the index were chosen from the measured variables. The original measurement data were transformed into quality values using so-called value functions in standard procedures which have been used earlier for the calculation of values of water quality indices. The basic idea behind the construction of the value functions for the general lake water quality index was to develop functions which could indicate how individual measurement results compare with the whole deepwater lake data. Cumulative relative frequencies of the variables of the data under examination were chosen as the basis for developing value functions. Regression analysis was used in developing the value functions used in the index. In most cases the index performed well. (Baker-IVI)
W86-00673

POTENTIALLY TOXIC BLUE-GREEN ALGAE (CYANOBACTERIA) IN FINNISH NATURAL WATERS,

Helsinki Univ. (Finland). Dept. of Limnology.
For primary bibliographic entry see Field 5B.
W86-00674

FILLING IN THE GAP BETWEEN HYDROLOGY AND HYDROBIOLOGY - THE VIEWPOINT OF A HYDROLOGIST,

National Board of Waters, Helsinki (Finland). Water Research Inst.
E. Kuusisto.
Aqua Fennica, Vol. 14, No. 2, p 155-169, 1984. 9 Fig, 39 Ref.

Descriptors: *Morphometry, *Lakes, *Hydrology, Ice cover, Thermal conditions, Water balance, Limnology, Hydrodynamics, Mixing, Water currents.

Considerable progress has been made in recent years in the study of lake hydrodynamics. Hydrodynamic processes occurring in lakes are divided into the following groups: surface phenomena (wind generated waves, wind generated surface oscillations, and waves due to changes in discharge); internal currents (flow through the lake, and currents due to surface movements); and transport phenomena (mixing and stratification, and diffusion). All dynamic processes in a lake are characterized by spatial heterogeneity. This leads to incomplete mixing and uneven distribution of chemical and biological constituents within the water body. Simple mass balance relationships between the inputs of these constituents and their concentrations in water samples are usually not valid. Specific attention is given to wind induced currents, advective currents, convective currents, and dynamic biological limnology. Also discussed are morphometry, thermal conditions, ice and snow cover, and water balance. (Baker-IVI)
W86-00675

WATER QUALITY MODEL FOR LAKE KUORTANEENJARVI, A POLYHUMIC FINNISH LAKE,

Helsinki Univ. of Technology, Espoo (Finland). Dept. of Civil Engineering.
O. Varis.
Aqua Fennica, Vol. 14, No. 2, p 179-187, 1984. 7 Fig, 4 Tab, 11 Ref.

Descriptors: *Polyhumic lakes, *Finland, *Nutrients, *Simulation, *Algal growth, *Lake Kuortaneenjarvi, Eutrophication, Model studies, Phosphorus, Nitrogen, Algal blooms..

A description is offered of nutrient dynamics and algal growth in a small northern polyhumic lake in terms of mathematical simulation. Lake Kurotaneenjarvi is located in the middle reaches of Lapuanjoki River. The area has a dense population and is rather poor in lakes. Recreational use of this lake is abundant. Slight eutrophication and blooms of blue green algae hinder fisheries and recreational users. Municipal waste waters cause about 5-10% of the total nutrient loading but in the summer this proportion rises to 30%. The application of the systems analysis approach in the modelling context proved helpful. Phosphorus and nitrogen cycles were simulated. Particular attention was given to simulation of blue green algae separately from other planktic algae. Lake Kurotaneenjarvi consists of two basins which both were simulated separately with identical lumped parameters models. The model was calibrated using observations from the upper basin and applied to the lower basin as a preliminary validation. The simulation results of calibrated state variables as regards to correctness with time as well as with level were relatively accurate. The model can be used in estimating the influence of changing nutrient loadings on the lake metabolism. Presumably, it cannot be directly applied to other lake ecosystems. (Baker-IVI)
W86-00677

NATURAL OCCURRENCE OF PIKE-PERCH (STIZOSTEDION LUCIOPERCA (L.)) AND SUCCESS OF INTRODUCTIONS IN RELATION TO WATER QUALITY AND LAKE AREA IN FINLAND,

Finnish Game and Fisheries Research Inst., Helsinki. Fisheries Div.
H. Lehtonen, T. Miina, and T. Frisk.
Aqua Fennica, Vol. 14, No. 2, p 189-196, 1984. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Lakes, *Finland, *Fish populations, *Pike-perch, Water quality, Limnology, Eutrophication, Phosphorus, Fisheries.

The relative abundance of pike-perch in lakes in Finland and the success of introductions of this species in relation to water quality and the lake area are described. The introductions of the fish are carried out with fry, fingerlings or larger fish with eyed ova. The success of these introductions depends on the quality of the lake and also on the quality and size of the fish used for stocking. Introductions in some areas have succeeded best when yearlings or two-year old pike-perch are used as stocking material. The higher the concentration of phosphorus in the lake, the more successful has been the introduction. In polyhumic lakes the results have often been poorer than elsewhere. Most introductions are carried out in small lakes the majority having a surface area of 3 sq km or less. About half of the introductions into small lakes were successful, whereas in large lakes with areas over 11.7 sq km only 22% of the introductions resulted in self-sustaining populations. It is not clear whether the result of introduction is primarily determined by the lake area or some other factor. It is possible that introductions are carried out more carefully in small than in large lakes because the fishing rights do not belong to so many people and the persons introducing the pike-perch can more often enjoy the results themselves. One reason for better results in small lakes may be that the large lakes suitable for the occurrence of pike-perch have mostly already had natural pike-perch stocks, whereas small lakes have not usually had pike-perch in their original fish fauna. (Baker-IVI)
W86-00678

IODINE CONTENT OF THE TISSUES OF THE VENDACE (COREGONUS ALBULA L.) IN CORRELATION TO THE IODINE CONTENT OF THE AMBIENT WATER,

Kuopio Univ. (Finland). Dept. of Applied Zoology.
E. Lahti, and O. Lindqvist.
Aqua Fennica, Vol. 14, No. 2, p 197-203, 1984. 8 Fig, 2 Tab, 23 Ref.

Descriptors: *Iodine, *Vendace, *Finland, *Fish physiology, Biological magnification, Brackish waters, Oligotrophic lakes, Fish food, Animal tissues, Animal physiology.

The iodine contents in the ambient water was correlated with iodine content in the vendace tissues, which also allows the calculation of the biomagnification factors of this element in the fish tissue. The material was collected in 1980 from the northern part of the Bothnian Bay (brackish water) and from inland lakes in Finland. All lakes represent the oligotrophic or dys-oligotrophic type. The thyroid contained the highest amount of iodine and the muscle, the lowest. Little seasonal variation was evident in the iodine content of the thyroid. Muscle and liver contents were lowest in the summer. Iodine levels in the ovary remained rather unchanged or increased slightly towards the spawning period in the fall. Enrichment coefficients for iodine in the different tissues were generally higher in fish from lakes with low iodine levels, and vice versa. The brackish water is richest in iodine and the vendance tissues there contained the least amounts of the substance. The main route for iodine into the vendace may be through its food, though during the lean seasons it may have to rely on its iodine stores in tissues. (Baker-IVI)
W86-00679

GROWTH IN BIOMASS OF BALANUS BALANOIDES YOUNG AT VARIOUS CURRENT VELOCITIES,

Akademiya Nauk SSSR, Moscow. Inst. of Evolutionary Morphology and Animal Ecology.
B. Y. Vilenkin, N. A. Pertsov, N. A. Plotnikova, and L. P. Tsygankova.
Doklady Biological Sciences, Vol. 278, No. 1-6, p 552-554, March, 1985. 1 Tab, 8 Ref.

Descriptors: *Barnacles, *Biomass, *Current velocity, Growth rates, Water currents, Growth stages, Growth kinetics.

The dependence of total biomass growth of Balanus balanoides young was shown to depend on current velocity approximately according to the Rashevskii hypothesis on steady-state nutrition as first applied by Monod with microorganisms. The equation has the form $k = 0.0496\ U/U + 9.74$, where k is the specific growth rate (per day) and U is the current velocity (cm/sec). The coefficient in the numerator of this equation determines the growth rate that is maximal for the given age, temperature, and experimental conditions, and appears to be a conservative indicator. The coefficient in the denominator is highly dependent on the food concentration in the flowing water medium. The hyperbolic function best corresponding to the experimental data in the present study resembles that long established for concentration dependency of growth (or activity) of microorganisms. Values for the specific rate of biomass growth during the observation of barnacle growth on plates were obtained at four levels of current velocity at which repeatable results were obtained. The specific growth rate was calculated as $k = \ln 1/32\ (L/l)$, where l is the sum of shell diameters on both plates at the start of the experiment, L is the same sum on day 32. The quantities obtained were as follows: $U = 4.45$, $k = 0.0154$; $U = 8.90$, $k = 0.0253$; $U = 17.80$, $k = 0.297$; $U = 22.45$, $k = 0.0353$. Choice of the Rashevskii hypothesis was based on selection of the most significant linear regression obtained when these data were transformed in various ways. (Rochester-IVI)
W86-00721

EFFECT OF VELOCITY OF WATER FLOW ON GROWTH OF COLONIAL HYDROIDS (HYDROZOA, THECAPHORA),

Moscow State Univ. (USSR).
N. N. Marfenin.
Doklady Biological Sciences, Vol. 278, No. 1-6, p 655-657, March, 1985. 1 Tab, 8 Ref.

Descriptors: *Hydrozoa, *Water currents, *Velocity, *Current velocity, *Animal growth, Growth rate, Feeding, Animal behavior.

Percentage increase in colony size of hydroids generally decreased as current velocity increased over the range 9-75 cm/sec, but there were differences among the four species tested. Obelia loreni (Allm.) grew best at a flow velocity of 9 cm/sec. At 31 cm/sec, a distinct decrease in growth rate was apparent, and at 51 and 75 cm/sec, there was virtually no increase in colony size over 8 days of observation. O. longissima (Pall.) and O. geniculata (L.) colonies ceased to grow only at 75 cm/sec, but O. longissima showed a marked change in rate of increase in colony size at 51 cm/sec. Dynamena

pumila (L.) did not cease growth at any current velocity, but growth was less at the highest and lowest velocities employed. Orientation of the colonies of all species to the direction of water flow did not affect their growth. The mechanism of action of current velocity on growth is linked to feeding behavior - anchoring, retaining, and ingesting the prey (Artemia nauplii) transported past the hydranth by the flow of water. When currents are powerful, pressing of axial shoots to the substrate and lateral branches to the stalk makes feeding difficult or impossible. The species used here have differing degrees of stalk rigidity, with the shoots of O. loveni being weakest and those of D. pumila being strongest. (Rochester-IVI)
W86-00722

NUTRIENT FLUXES IN EUTROPHIC COASTAL LOUISIANA FRESHWATER LAKE,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. A. Stow, R. D. De Laune, and W. H. Patrick, Jr.
Environmental Management, Vol. 9, No. 3, p 243-251, May, 1985. 12 Fig, 1 Tab, 19 Ref.

Descriptors: *Nutrients, *Eutrophic lakes, *Louisiana, *Lac des Allemands. Carbon, Nitrogen, Phosphorus, Sedimentation rates, Runoff, Cyanophyta, Water quality, Water pollution sources.

Nitrogen and phosphorus cycling in a eutrophic Louisiana freshwater lake system (Lac des Allemands) was studied. Nutrients from runoff entering the lake, as well as sediment-interstitial and lake water nitrogen and phosphorus fractions, were measured seasonally. Sedimentation rates in the lake were determined using Cs-137 dating. Phosphorus levels in the lake were found to be largely dependent on concentrations in the incoming bayou water from upland drainage. Lake water concentrations appear to respond to fluctuations in incoming waters. Laboratory equilibrium studies showed bottom sediments in the lake are a major sink for the incoming dissolved orthophosphate phosphorus. Total nitrogen concentrations in the lake water generally exceeded incoming runoff concentrations, suggesting fixation by the large blue-green algae population in the lake as being the major source of nitrogen to the system. Sedimentation ranged from 0.44 cm/year to 0.81 cm/year, depending on the proximity to the inlet bayous. Even though the lake is eutrophic the sediment served as a buffer by removing large amounts of carbon, nitrogen, and phosphorus through sedimentation processes. Carbon, nitrogen, and phosphorus were accumulating in the sediment at rates of 60, 7.1, and 1.1 g/sq m/year, respectively. The water quality of the lake is likely to continue to decline unless measures are taken to reduce municipal, industrial, and agricultural inputs of phosphorus into the lake. (Author's abstract)
W86-00724

TRACE-METAL CONCENTRATIONS IN SEDIMENTS FROM TWO CLOSED-BASIN LAKES, ANTARCTICA,

New Hampshire Univ., Durham. Dept. of Earth Sciences.
W. B. Lyons, P. A. Mayewski, and F. H. Chormann, Jr.
Chemical Geology, Vol. 48, No. 1/4, p 265-270, March, 1985. 2 Fig, 1 Tab, 32 Ref. NSF grant DPP-79-0755.

Descriptors: *Antarctic, *Trace metals, *Lake sediments, Polar regions, Iron, Manganese, Copper, Lead, Zinc, Water pollution sources, Groundwater, Calcium chloride, Brines, Don Juan Pond, Shea Sisters Lake.

Sediment trace-metal data were collected from two closed-basin lakes in Antarctica where no macro-organism disturbance of the historic record has taken place due to the harsh environment. Don Juan Pond is located in the western end of one of the major ice-free valleys, in southern Victoria Land. Shea Sisters Lake is an internally drained water body located in an ice-free portion at the southeastern end of the Morozimi Range. Sediment samples were analyzed for 25% HCl leachable Fe, Mn, Cu, Pb, Zn. The data were normalized to 100% silt-clay. The Pb concentrations in the sediment of Don Juan Pond were extremely low, indicating Pb remobilization from these sediments by CaCl2-rich brines. This process may have a profound effect on the evolution of groundwater in the ice-free valleys of Antarctica. A possible surficial enrichment of Pb was observed in Shea Sisters Lake samples from northern Victoria Land. This suggests that this area of Antarctica may have been affected by worldwide fossil fuel burning. (Moore-IVI)
W86-00770

CHEMICAL COMPOSITION OF RIVER SEDIMENTS FROM THE INDIAN SUB-CONTINENT,

Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 2J.
W86-00771

MATHEMATICAL MODEL FOR ANALYSIS OF SEDIMENT CORE DATA: IMPLICATIONS FOR ENRICHMENT FACTOR CALCULATIONS AND TRACE-METAL TRANSPORT MECHANISMS,

Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 5B.
W86-00772

USE OF SEEPAGE METERS TO ESTIMATE GROUNDWATER NUTRIENT LOADING TO LAKES,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 7B.
W86-00788

BOTTOMLAND VEGETATION DISTRIBUTION ALONG PASSAGE CREEK, VIRGINIA, IN RELATION TO FLUVIAL LANDFORMS,

Geological Survey, Reston, VA.
C. R. Hupp, and W. R. Osterkamp.
Ecology, Vol. 66, No. 3, p 670-681, June, 1985. 6 Fig, 4 Tab, 59 ref.

Descriptors: *Passage Creek, *Virginia, *Terrain analysis, *Vegetation, *Bottomlands, Channel morphology, Statistical analysis, Floodplains, Flooding, Riparian vegetation.

Persistent distribution patterns of woody vegetation within the bottomland forest of Passage Creek, Virginia, were related to fluvial landforms, channel geometry, streamflow characteristics, and sediment-size characteristics. Vegetation patterns were determined from species presence as observed in transects and traverses on landforms developed along the stream. Distinct species distributional patterns were found on four common fluvial geomorphic landforms: depositional bar, active-channel shelf, floodplain, and terrace. Independent hydrologic characteristics (flow duration and flood frequency) were determined for each of the landforms. Vegetation data were analyzed by binary discriminant analysis, principal components analysis, and detrended correspondence analysis. Results and related field observations suggest that certain species are significantly associated with specific fluvial landforms. Vegetation patterns appear to develop more as a result of hydrologic processes associated with each fluvial landform rather than from sediment-size characteristics. Flood disturbance may be an important factor in maintaining the vegetation patterns, which may therefore be used as indicators for particular hydrogeomorphic site conditions. (Author's abstract)
W86-00826

HISTORICAL CHANGES IN SUBMERGED MACROPHYTE COMMUNITIES OF UPPER CHESAPEAKE BAY,

California Univ., Santa Barbara. Dept. of Geography.
F. W. Davis.
Ecology, Vol. 66, No. 3, p 981-993, June, 1985. 7 Fig, 5 Tab, 65 Ref.

Descriptors: *Aquatic plants, *Chesapeake Bay, *Seeds, *Sediment cores, *History, Eutrophication, Water pollution effects, Macrophytes, Aquatic weeds, Elodea, Land use, Vallisneria, Najas, Myriophyllum.

Submerged macrophyte species that occurred at the head of Chesapeake Bay over the past 1800 yr have been documented by analyzing seed assemblages in sediments from a tidal embayment. To help interpret seed stratigraphy in the estuary, seed settling behavior was studied in the laboratory, and the relationship between parent vegetation and resulting sedimentary seed assemblages was studied in a tidal creek. Results suggest that estuarine seed assemblages are primarily locally derived and have high spatial variability, and that because of differences in seed output or preservation some species are overrepresented in the seed record. Seed assemblages in four cores from the estuary are accordingly treated as presence/absence data. The record of local submerged macrophytes was profiled in 7-100 yr intervals, using sediment dates obtained radiometrically and by pollen stratigraphy. Vallisneria americana, Najas flexilis, N. gracillima, and Elodea canadensis were consistently present for 1500-1600 yr prior to colonization by Europeans (1730 AD), while N. guadelupensis appeared 300-400 yr prior to European settlement. Vallisneria americana was the only local species continuously present for 150 yr following initial deforestation. After 1930, N. guadalupensis and N. flexilis appeared more regularly in the record, and two local expansions of Myriophyllum spicatum were registered. Native submerged aquatic vegetation disappeared from the area between 1964 and 1972, and has shown little recovery since that time. Community changes after 1930 appear to be related to increased eutrophication. (Author's abstract)
W86-00828

RELATIONSHIPS BETWEEN SURFACE SEDIMENT DIATOM ASSEMBLAGES AND LAKEWATER CHARACTERISTICS IN ADIRONDACK LAKES,

Indiana Univ. at Bloomington. Dept. of Biology.
D. F. Charles.
Ecology, Vol. 66, No. 3, p 994-1011, June, 1985. 11 Fig, 5 Tab, 71 Ref. NSF grant DEB 77-03907 and DEB 79-12210.

Descriptors: *Lake sediments, *Diatoms, *Adirondack Mountains, *New York, *Water quality, *Species composition, Hydrogen ion concentration, Acid lakes, Ecological effects, Mountain lakes, Elevation, Water temperature, Sulfuric acid, Chlorine, Silicone, Phosphorus, Chlorophyll a, Acidity.

Relationships between surface sediment diatom assemblages and lakewater characteristics were studied in 38 lakes in the Adirondack Mountains of northern New York. Most of the lakes are dilute, poorly buffered, and oligotrophic to mesotrophic. The diatom flora (240 taxa identified) is typical for circumneutral to acidic lakes. The purposes of this study were to identify the environmental factors most strongly related to the distributions of diatom taxa and the overall composition of diatom assemblages, and to derive equations to infer lakewater pH from diatom assemblage data. Relationships between diatom assemblages and environmental gradients were analyzed using reciprocal averaging ordination (RA). Correlations between RA axis 1 and pH-related factors were strong (pH, r squared = 0.90; alkalinity, r squared = 0.81; p(Ca positive charges), r squared = 0.67; pMg, r squared = 0.78; pNa, r squared = 0.48; p-total Al, r squared = 0.58; conductivity, r squared = 0.47). Correlations were weaker (but still statistically significant) with elevation, epilimnion temperature, and concentrations of SO4, Cl, and Si. Total P, chlorophyll a, water color, and mean depth were not important in explaining differences among assemblages. Cluster analysis of lakes and diatom taxa, multiple regression of taxon cluster groups with lakewater pH, and the occurrence patterns of individual taxa also indicated that pH-related factors are closely associated with diatom distribu-

tions. Euplanktonic taxa were present only rarely in surface sediments of lakes having a pH < 5.8, alkalinity < 20 micro-mol/L, and concentrations of Ca positive charges < 100 micro-mol/L and total Al > 60 micro-g/L. Predictive equations were derived for inferring lakewater pH from diatom assemblage data. Most were based on approaches of Hustedt (1939), Nygaard (1956), Merilainen (1967), and Renberg and Hellberg (1982). Agreement between predicted and measured pH was very good; r squared values ranges from 0.61 to 0.94 and SE from 0.28 to 0.60 pH units. These predictive relationships can be used to interpret stratigraphic diatom assemblages to reconstruct lake pH histories. No significant relationships existed between Araphidinae:Centrales ratios and measures of trophic status. (Author's abstract)
W86-00829

PHOSPHORUS SPIRALLING IN A WOODLAND STREAM: SEASONAL VARIATIONS,

Oak Ridge National Lab., TN. Environmental Sciences Div.
P. J. Mulholland, J. D. Newbold, J. W. Elwood, L. A. Ferren, and J. R. Webster.
Ecology, Vol. 66, No. 3, p 1012-1023, June, 1985. 4 Fig, 5 Tab, 43 Ref. U.S. DOE contract DE-AC05-840R21400.

Descriptors: *Nutrient spiralling, *Phosphorus radioisotopes, *Cycling nutrients, *Seasonal variation, *Walker Branch, *Tennessee, Radioisotopes, Spiralling length, Particulates, Organic matter.

Four radiotracer releases were performed over an annual period in 1981-1982 to determine seasonal variation in indices and pathways of phosphorus spiralling in Walker Branch, a small woodland stream in eastern Tennessee, USA. Each release consisted of an addition of approximately 370 MBq each of carrier-free labeled PO4 and labeled H2O over a 1-h period during baseflow. Concentrations of P-32 and H-3 dissolved in stream water were measured intensively at several stations downstream from the radiotracer input during and immediately following each release. Activity of P-32 in coarse particulate organic matter (CPOM), fine particulate organic matter (FPOM), and aufwuchs was measured 2-3 h after each release and at various intervals for 7 wk. Total biomass of CPOM, FPOM, and aufwuchs at the time of each release was also measured. Uptake of labeled PO4 from the water was greatest in November and lowest in August. Uptake length (Sw) of phosphorus, defined as the average distance travelled by a PO4 ion dissolved in water, varied from 22 m in November to 97 m in August. Uptake of PO4 by CPOM was generally greatest, with approximately 50% of total uptake, while that by aufwuchs was lowest, with $< 15\%$ of the total. CPOM abundance was the major determinant of whole-stream PO4 uptake rate and Sw. Turnover length (Sp) of phosphorus, defined as the average distance traveled by an atom of P taken up by particulate material, was short compared to Sw varying from 1 m in November to 3 m in January. Consequently total spiralling length (S) of P varied from 23 m November, just after peak autumn leaf fall, to 99 m in August, and reflected primarily the travel of P in the dissolved form. Our results indicate that the greatest increase in Sw (and consequently in S) in Walker Branch occurs in late autumn or winter after storms reduce the abundance of CPOM in the lower portions of the stream bed. Although we calculate that Sp may increase by one to two orders of magnitude for short periods during storms, the greatest effect of storms on P spiralling over the long term is their impact on the quality and quantity of CPOM and FPOM in the stream bed after the return to baseflow. For most of the year, detrital organic carbon probably influences phosphorus spiralling more than phosphorus spiralling influences the processing of organic carbon in Walker Branch. Only during the fall and early winter periods, when CPOM abundance is high and Sw is short, does phosphorus spiralling exert strong control over biotic processes downstream. (Author's abstract)
W86-00830

NITROGEN TRANSFORMATIONS AND LOSS IN FLOODED SOILS AND SEDIMENTS,

Agricultural Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 2K.
W86-00849

LAKE MODELING: STATE OF THE ART,

R. H. French.
CRC Critical Reviews in Environmental Control, Vol. 13, No. 4, p 311-357. 6 Fig, 10 Tab, 146 Ref.

Descriptors: *Lake modeling, *Limnology, *Reservoirs, *Model studies, Hydrodynamics, Cycling nutrients, Phosphorus, Steady-state models, Nitrogen, Limiting nutrients.

Modeling of hydrodynamics and chemical and biological processes in surface water impoundments (ie, natural lakes and man-made reservoirs) is reviewed. Basic concepts of one-, two-, and three-dimensional hydrodynamic models are available now that they are conceptually correct, numerically efficient, reasonably accurate when used correctly, and relatively well documented. Research models typically incorporate the most modern methods, but have inadequate documentation and have not been sufficiently tested. Applied models may not employ state-of-the-art methods, but are well documented and have been comprehensively tested. The latter are to be preferred. Impoundment modeling is further advanced in the area of hydrodynamics than in the areas of chemical and biological processes. Additional research is needed regarding the linkage among hydrodynamic, chemical, and biological processes. The flux of nutrients across the sediment interface cannot be accurately simulated without site-specific studies. Steady-state loading and biomass models, when properly employed, can provide cost-effective results which complement the results that can be obtained from dynamic water quality models. These two types of models should be used together in design of impoundment restoration programs. The limits of coefficient validity in steady-state models need to be further denied. Although most impoundments studied to date appear to have been phosphorus-limited, there exist a significant number of nitrogen-limited impoundments. (Rochester-IVI)
W86-00850

SOME MIRE SYSTEMS IN JAPAN,

Aberdeen Univ. (Scotland). Dept. of Botany.
C. H. Gimingham.
Transactions of the Botanical Society of Edinburgh, Vol. 44, No. 3, p 169-176, 1984. 1 Fig, 2 Ref.

Descriptors: *Japan, *Mires, *Peat bogs, *Wetlands, Ecosystems, Vegetation, Habitats, Conservation.

Some examples of different types of mires in Japan are described and compared with their European counterparts. The parallels in ecosystem development and vegetation physiognomy with mires in equivalent habitats in Europe are striking. Numerous species are common to both, in other cases closely related species fill similar niches. In some instances, however, a given species displays marked ecological differences in the two regions. The flood plain mires of Hokkaido and the mires of Oze and Kirigamine are among the finest examples of their kind in the world. Those in the mountain districts are adequately protected in National Parks: it is suggested that the lowland mires of Hokkaido require further protection. (Author's abstract)
W86-00904

LIMNOLOGY AND MACROPHYTE VEGETATION OF A DEEP, CLEAR LIMESTONE LAKE, LOCH BORRALIE,

Saint Andrews Univ. (Scotland). Dept. of Plant Biology and Ecology.
D. H. N. Spence, A. M. Barclay, and E. D. Allen.
Transactions of the Botanical Society of Edinburgh, Vol. 44, No. 3, p 187-204, 1984. 4 Fig, 3 Tab, 26 Ref.

Descriptors: *Loch Borralie, *Scotland, *Limnology, *Macrophytes, Nutrients, Interstitial water, Aquatic plants, Lakes, Limestone lakes.

A bathymetric survey shows Loch Borralie (Scotland) to have a maximum depth of 36 m. It is one of the most transparent lakes in Britain and is unstratified and poor in nutrients and phytoplankton, although the interstitial water of its calcareous muds is rich in nitrogen and phosphorus. Forty-four percent of the loch surface is densely colonized by macrophytes. The littoral to 2 m bears very sparse Chara aspera var. lacustris and the zone from 2 to 4.5 m is dominated by tall Hippuris vulgaris, Myriophyllum spicatum and four Potamogeton spp., for which Chara and Nitella (principally C. globularis and N. flexilis) form an understorey. Three Potamogeton species persist to 6.5 m in an undulating Chara-Nitella 'meadow' which continues, alone, to between 12 and 15 m depth. Loch Borralie is the most deeply and possibly the most extensively colonized lake in the United Kingdom. (Author's abstract)
W86-00905

AQUATIC ANGIOSPERM COMMUNITIES FROM LOCHS ON RHUM,

Saint Andrews Univ. (Scotland). Dept. of Botany.
A. M. Farmer.
Transactions of the Botanical Society of Edinburgh, Vol. 44, No. 3, p 229-236, 1984. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Lochs, *Aquatic plants, *Macrophytes, *Rhum, *Scotland, Lakes, Ponds, Lochans, Exposure, Substrate.

The aquatic angiosperm communities from twenty lochs and lochans on the island of Rhum National Nature Reserve (Scotland) were surveyed. The sites are mostly located around the major lochs of the central part of Rhum, but a small number of more widely distributed lochs are also included so that local differences in vegetation may be noted. Species lists are given for each site. The vegetation in the study sites is comparable to those of poorer lochs surveyed in other parts of Western Scotland. Aquatic vegetational cover is sparse and only a limited number of plant communities are present, predominantly those involving Lobelia dortmanna and Littorella uniflora as dominants or co-dominants, and a more restricted representation of communities with Equisetum fluviatile, Phragmites australis or Nymphaea alba subsp. alba. Exposure and poor substratum are suggested as factors causing limited plant growth. The littoral zones of many lochs are strewn with large rocks, which not only restrict plant growth but create further turbulence. Only in a few of the larger lochs, with sheltered bays and deeper water, are there varying plant communities. (Moore-IVI)
W86-00906

DYNAMICS OF THE STRUCTURE OF THE ICHTHYOCENOSIS OF LAKE UBINSKOYE,

R. I. Setsko, and L. I. Tereshchenko.
Journal of Ichthyology, Vol. 24, No. 5, p 71-77, 1984. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Ichthyocenosis, *Lake Ubinskoye, *USSR, *Lake fisheries, Fisheries, Fish populations, Fish harvest, Population dynamics, Water level, Species composition.

The factors controlling the structure of the ichthyocenosis of Lake Ubinskoye, western Siberia (USSR) were analyzed based on records of lake levels and commercial catches from 1930-1981, original data, and published results. Lake Ubinskoye has a surface area of 50,000 hectares and an average depth of 2.14 m, so that slight fluctuations in lake level produce considerable changes in area and volumes of the lake. During the past 40-50 yr, the ichthyocenosis of the lake has been experiencing intensified pressure from external influences: changes in lake level and exploitation until 1952, changing lake level regime, exploitation, and sudden appearance of the acclimatized bream after 1952, and since 1968, changes in lake level regime, exploitation, winter kill, introduction of peled, and reacclimatization of bream after winter kill. Three trends in qualitative transformation of the ichthyocenosis are apparent: (1) change in the number of basic (commercial) species, which are character-

ized by the complexity index (H sub m = log base 2 n, where n = the number of species in the commercial catch), (2) replacement of some basic species by others, without any change in the overall total, which is characterized by the index for the degree of species similarity (a modification of the Sorensen index, K = c/a x 100%, where c = the number of species common to two lists being compared and a = the number of species in one of the lists of interest), and (3) redistribution of the species in the overall biomass, a parameter indicated by the 'entropy' (H = sum of p sub i log base 2 p sub i, where p sub i is the share of the species in the general biomass) and 'relative organization' (R = 1 - H/H sub m). The redistribution of stock of different species into the general biomass is a constantly active mechanism regulating the structure of the ichthyocenosis; only when regulation at this level becomes no longer possible do mechanisms of profound changeovers come into play. (Rochester-IVI)
W86-00912

ORGANIC MATTER IN GRAVEL STREAMS (PROJECT RITRODAT-LUNZ),

Biological Station, Lunz am See (Austria).
M. Leichtfried.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 4, p 2058-2062, 1985. 9 Fig, 13 Ref.

Descriptors: *Benthos, *Organic matter, *Gravel streams, *Particle size, Bacteria, Fungi, Particulate matter, Stream sediments, Sediments.

In gravel streams in mountainous areas, the energy basis is nearly exclusively allochthonous organic matter, mainly particulate organic matter (POM) from soil erosion and aerial drift. The main energy pathway connects POM over the microbenthos (fungi and bacteria) with the so-called detritivorous animals (more appropriately called pomivorous animals). Pomivorous animals prefer particles colonized by fungi and bacteria as food. This study concentrates on bed sediments, and their surfaces suitable for colonization by bacteria and fungi. The relative percentage of sediment grains smaller than 1 mm increases with sediment depth, but rarely exceeds 10%. POM concentrations decrease rapidly with increasing grain size. POM concentrations are always high in the grain size-class 0.5 to 1 mm, making this size class most valuable for pomivorous animals. In any stream-ecosystem analysis, the amount of bed sediment-surface suitable for colonization by the microbenthos is a main parameter, not to be overlooked. (Moore-IVI)
W86-00913

EFFECT OF DROUGHTS ON THE INVERTEBRATE COMMUNITIES OF HIGH MOUNTAIN STREAMS,

Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
A. Kownacki.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 4, p 2069-2072, 1985. 5 Fig, 1 Ref.

Descriptors: *Invertebrates, *Droughts, *Poland, Seasonal variation, Streams, Stream biota, Mayflies.

Studies of the invertebrate fauna of the high mountain stream Sucha Woda (High Tatra Mountains, Poland) indicate that droughts or winter freezing are important causes behind the development of a specific fauna in the kryon zone. Two stations were sampled: station 1, at 1,600 m, was below the outflow of Lake Czarny Staw Gasienicowy, and had water flowing for 5-7 mo following the beginning of snow melt (May, June) and station 2, at 1,000 m altitude, was below the sector of the permanent stream, and had water flowing from the time of snow melt until August in dry years or until the beginning of winter in wet years. When the streams begin to flow, two periods of faunal development can be distinguished. In the first period, autochthonous elements, adapted to surviving drought, dominate (Prosimulium and Diamesa latitarsis at station 1 and Eukiefferiella cyanea (riffle) Parametriocnemus borealpinus (pool) at station 2). In the second period, the dominant elements are those that migrate from other places either by downstream drift (station 2 only) or aerially (both stations). In the summer drift, mayflies (Baetis alpinus) are most important. In a temporary stream situated below a sector of permanent stream, the fauna adapted to life in temporary streams exists only for a relatively short period, and is soon replaced by a fauna typical of permanent streams whose representatives are better adapted to living in the stream. On the other hand, at higher altitudes, the opportunity is much smaller for the fauna of permanent streams to inhabit a given reach of stream, and occurs, though not always, by the end of the growing season. Thus, species characteristic of temporary streams remain for most or all of the season. (Rochester-IVI)
W86-00915

CHEMICAL-PHYSICAL CHANGES ASSOCIATED WITH ENVIRONMENTAL GRADIENTS IN THE OKA RIVER BASIN,

E. Orive, and I. Arteaga.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 4, p 2073-2076, 1985. 3 Fig, 5 Ref.

Descriptors: *Oka River basin, *Spain, *Physicochemical characteristics, *Environmental g[illegible]ent, *Biotic index, Geochemistry, Water temperature, Conductivity, Alkalinity, Hydrogen ion concentration, Oxygen, Nutrients, Phosphates, Nitrates, Nitrites, Chloride, Benthos, Macroinvertebrates, Cluster analysis, Principle components analysis, Statistical analysis.

Physical and chemical parameters and biotic index (Tuffery and Verneaux) data, when subjected to multivariate analyses, defined differences among sampling sites in the Oka River basin (North Spain) that appeared to be related principally to geologic substrate and distance from the headwaters. At each of 124 stations, temperature, conductivity, alkalinity, pH, oxygen, nutrients (phosphate, nitrate, and nitrite), and chloride were measured and benthic macroinvertebrates were collected. Longitudinal trends of the main variables were examined by principal components analysis and cluster analysis. The influences of sewage effluents, chloride from sea spray, and changes in conductivity resulting from the change from non-calcareous (basalt and sandstone) to calcareous (principally chalk) substrates were apparent in the data. The biotic index indicated environmental stress in the lower reaches of the basin. Cluster analysis separated the stations into groups among which the differences were determined mainly by their distance from sea level. (Rochester-IVI)
W86-00916

PATTERNS OF MACROINVERTEBRATE DISTRIBUTION IN THE LLOBREGAT RIVER BASIN (NE SPAIN),

Barcelona Univ. (Spain). Dept. de Ecologia.
G. Gonzalez, X. Millet, N. Prat, and M. A. Puig.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, No. 4, p 2081-2086, 1985. 3 Fig, 1 Tab, 7 Ref.

Descriptors: *Macroinvertebrates, *Spatial distribution, *Species composition, *Llobregat River Basin, *Spain, Streams, Rivers, Ecological distribution, Aquatic insects, Water pollution effects.

Patterns of macroinvertebrate (mainly insect) distributions in the Llobregat River drainage (northeastern Spain) showed that there were five groups (mountain stream species, stream species, small stream species, riverine species, and special distributions). Sampling was conducted at 74 sites, which were visited in September and December 1979 and April and August 1980. The mountain species group had a reduced distribution, with high percentage abundances in the upper reaches. The stream species group had a distribution throughout the entire upper basin, with the highest percentage values in the Llobregat main channel. The small stream group was distributed in all the lateral small channels of the basin, with the highest percentage values in the small streams; the only difference separating this group from the stream species was the lower order of streams it occupied. The riverine species had the widest distribution observed, and were found either in lateral small streams or in the main channel, although the highest percentage values were found in the lower reaches of the main channel. Special distributions included some species that did not fit the other patterns. These included species that appeared to be restricted due to salinity, occurrence in springs, or for no apparent reason. Generally, the five groups showed successively greater overlap proceeding from the restricted distribution of the upper reaches toward the wider distributions of the lower zones. This reflects increasing uniformity of habitat in the downstream direction, which is produced by the hierarchical structure of the river basin and the pollution of the main channel. (Rochester-IVI)
W86-00917

VARIATIONS IN THE AMOUNT OF ORGANIC CARBON (DISSOLVED AND PARTICULATE) IN A SMALL MEDITERRANEAN MOUNTAIN STREAM (CORSICA) (LES VARIATIONS DES TENEURS EN CARBONE ORGANIQUE (DISSOUS ET PARTICULAIRE) D'UN PETIT TORRENT MEDITERRANEEN MONTAGNARD (CORSE)),

Ecole Normale Superieure, Paris (France). Lab. de Geologie.
M.-D. Loye-Pilot.
Verhandlung Internationale Vereinigung Limnology, Vol. 22, No. 4, p 2087-2093, 1985. 1 Tab, 10 Ref.

Descriptors: *Organic carbon, *Mountain streams, *Dissolved solids, *Particulate matter, *Corsica, *France, Flow discharge, Storms, Streams, Throughfall, Soil water, Forest watersheds, Soil erosion.

Dissolved and particulate (< 1 mm) organic carbon was measured during 2 years in a small mountain stream in a pristine forested mediterranean area (Corsica). The dissolved organic carbon (DOC) values range from 0.5 to 8.1 mg/l, those of the particulate organic carbon (POC) from 0.09 to 10.3 mg/l. The DOC/POC ratio fluctuates from 0.3 to 28, but generally DOC is far greater than POC. There is no correlation between DOC, POC, TOC (total organic carbon) and water discharge, but each storm event presents a DOC and POC increase with discharge, with various patterns of DOC, POC at discharge peaks. DOC during low-flow stage in summer and in-between storm events is close to the groundwater values (0.4-0.5 mg/l). DOC increases when throughfall and/or soil water reach the stream channel. The POC peak appears just before or during the rising limb of the hydrograph, or at the discharge peak. POC peak duration is generally very short; thus peak sampling is necessary for export computing. The removal rate of the POC stored in the channel and the soil erosion rate determine the export pattern of POC. DOC and POC variations depend on the storm events and, for each storm, on the recent hydroclimatic 'history' of the watershed. (Author's abstract)
W86-00918

ABIOTIC AND HYDROBIOLOGIC CHARACTERISTICS OF THE MEDITERRANEAN RUNNING WATERS (CARACTERISTIQUES ABIOTIQUES AND HYDROBIOLOGIQUES DES EAUX COURANTES MEDITERRANEENNES),

Aix-Marseille-3 Univ. (France). Faculte des Sciences et Techniques.
J. Giudicelli, M. Dakki, and A. Dia.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, Part 4, p 2094-2101, March, 1985. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Hydrology, *Lotic environment, *Mediterranean basin, *Aquatic animals, Running waters, Hydrobiology, Climate, Altitude, Precipitation, Distribution, Water temperature, Ecosystems.

The permanent Mediterranean watercourses have a regime characterized by irregularity of flow and by extreme hydrologic conditions. Precipitation is concentrated in short periods. Variations in thermal regime are also extreme. Studies were con-

ducted on four river systems in different parts of the Mediterranean basin to determine the principal characteristics of Mediterranean lotic ecosystems. The fauna is rich in endemics and is composed of a number of autochthonous lines which are unique to the ecosystems. The biocenotic analysis indicates that there is a notable longitudinal zonation; the zonation is generally compressed. In the eastern Mediterranean islands, there is no longitudinal zonation due to the low output of the streams. Both thermal and altitudinal influences are evident. (Moore-IVI)
W86-00919

2I. Water In Plants

SEASONAL AND DIURNAL WATER RELATIONS ADJUSTMENTS IN THREE EVERGREEN CHAPARRAL SHRUBS,

San Diego State Univ., CA. Systems Ecology Research Group.
W. D. Bowman, and S. W. Roberts.
Ecology, Vol. 66, No. 3, p 738-742, June, 1985. 3 Fig, 25 Ref. NSF grant DEB 80-25977.

Descriptors: *Seasonal variation, *Chaparral, *Diurnal distribution, *Plant water potential, Water potentials, Oak, Bearberry, Ceanothus, Pressure-volume approach, Turgidity, Water stress.

Pressure-volume curves were measured in three co-occurring chaparral shrubs, Arctostaphylos glandulosa, Quercus dumosa, and Ceanothus greggii, during a seasonal drought cycle. The pressure-volume approach was used to quantify diurnal and seasonal changes in plant water relations. Field measurements of plant water potentials and microclimate were also made to relate the pressure-volume results to the field setting. The seasonal trend was toward increasingly negative osmotic potentials with little (Q. dumosa) or no (A. glandulosa and C. greggii) recovery following the end of the drought. Shifts in the turgor loss point occurred both seasonally and diurnally. The larges diurnal shifts occurred during periods of maximum air temperature and minimum soil water potential. Concurrent field measurements of water potential indicate that these shifts were necessary for preventing turgor loss during periods of midday water stress in Q. dumosa and C. greggii. The shrubs differed in their mode of seasonal osmotic adjustment. Ceanothus greggii accomplished changes in osmotic potential by variation in the osmotic water volume; the other two shrubs appeared to accomplish such changes largely by solute variation while maintaining relatively constant osmotic water volumes. (Author's abstract)
W86-00827

EFFECT OF FLOODING OF SOIL ON GROWTH AND SUBSEQUENT RESPONSES OF TAXODIUM DISTICHUM SEEDLINGS TO SO2,

Wisconsin Univ.-Madison. Dept. of Forestry.
For primary bibliographic entry see Field 5C.
W86-00861

EFFECT OF DROUGHT ON METABOLISM AND PARTITIONING OF CARBON IN TWO WHEAT VARIETIES DIFFERING IN DROUGHT-TOLERANCE,

Melbourne Univ., Parkville (Australia). Plant Sciences Section.
M. E. Nicolas, H. Lambers, R. J. Simpson, and M. J. Dalling.
Annals of Botany, Vol. 55, No. 5, p 727-742, May, 1985. 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Drought resistance, *Partitioning, *Metabolism, *Carbon, *Wheat, Moisture deficiency, Drought, Plant physiology, Crop yield, Roots, Leaves, Osmotic pressure.

A model was constructed to describe the partitioning of carbon on the third and seventh day from anthesis for well-watered and droughted plants of two wheat varieties (Triticum aestivum L. cv. Warigal and Condor). The glasshouse-grown plants were detillered so that a simplified model could be derived for the main stem. The 9-d drought treatment, imposed just after anthesis during the period of cell division in the grains, reduced grain yield by 18% in Warigal and 30% in Condor. Net carbon fixation was up to 60% higher in Warigal than Condor towards the end of the drought period and this correlated with better osmotic adjustment in the flag leaf. Carbon partitioning between plant organs responded to water deficit more rapidly than net carbon fixation. On day 3, carbon allocation of the roots of droughted plants was maintained in Condor and increased by 14% in Warigal, whereas carbon allocation to the ear decreased in both varieties. However the roots did not compete well with the ear when the water deficit became more severe. Warigal accumulated 3 times more stem reserves that Condor under drought. In the roots, the pattern of carbon allocation between respiration and carbon accumulation changed soon after imposition of drought. Although total root respiration decreased under drought it became more energy efficient, particularly for Warigal, as less respiration took place via the alternative pathway. On day 3, the larger carbon allocation to the roots and the lower root respiration accounted for the 4-times larger sugar accumulation in droughted roots of Warigal compared with those of Condor. Osmotic adjustment in mature leaves and roots may be of importance for the maintenance of vital processes and for recovery after drought. (Author's abstract)
W86-00907

EFFECTS OF DROUGHT ON PARTITIONING OF NITROGEN IN TWO WHEAT VARIETIES DIFFERING IN DROUGHT-TOLERANCE,

Melbourne Univ., Parkville (Australia). Plant Sciences Section.
M. E. Nicolas, R. J. Simpson, H. Lambers, and M. D. Dalling.
Annals of Botany, Vol. 55, No. 5, p 743-754, May, 1985. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Drought tolerance, *Nitrogen, *Partitioning, *Wheat, Moisture deficiency, Crop yield, Leaves, Stem, Roots, Translocation.

A model was constructed to describe the translocation and partitioning of nitrogen on the seventh day after anthesis for well-watered and droughted plants of two wheat varieties (Triticum aestivum L. cv. Warigal and Condor). The glasshouse-grown plants were detillered so that a simplified model could be derived for the main stem. A 9-d drought treatment was imposed just after anthesis and this coincided with the period of endosperm cell division in the grains. Warigal, which had a higher grain yield than Condor under drought, absorbed up to 15-times more nitrogen and translocated 1.5-fold more nitrogen to the shoot via the xylem. In both varieties, nitrogen redistributed from vegetative organs accounted for more than 60% in control and 70% in droughted plants of the nitrogen needed for ear growth. The net loss of nitrogen increased by 4.3% in the leaves, but decreased by 60% in the stem under drought. Stem and roots appeared to play an important role in the nitrogen economy of droughted plants: less nitrogen was translocated directly to the grains from the senescing leaves and 40-60% more nitrogen was translocated to the roots. Nearly all the nitrogen reaching the roots in the phloem was reloaded into the xylem stream and translocated back to the shoot. The transfer of nitrogen through the stem was reduced under drought and this resulted in a constant C:N ratio of the grains which may be important in the regulation of endosperm cell division. (Author's abstract)
W86-00908

2J. Erosion and Sedimentation

ACCUMULATION OF SEDIMENT ORGANIC MATTER IN A HARDWATER LAKE WITH REFERENCE TO LAKE ONTOGENY,

University of Southern Mississippi, Hattiesburg. Dept. of Biological Sciences.
G. L. Godshalk, and R. G. Wetzel.
Bulletin of Marine Science, Vol. 35, No. 3, p 576-586, November, 1984. 5 Fig, 4 Tab, 33 Ref. DOE grants EY-75-S-02-1599 and COO-1599-243, Waterways Experiment Station grant DACW-39-82-M-1666.

Descriptors: *Organic matter, *Lake sediments, *Lake ontogeny, Detritus, Hardness, Primary productivity, Plant growth, Water depth, Sediment erosion, Sedimentation, Particulate matter, Limnology.

The occurrence and quality of detrital organic matter was investigated in sediments of a small hardwater lake. The objective of the study was to examine the interactions between plant productivity and growth form, water depth, sediment depth and potential erosion and deposition processes in the lake and their mutual impact on accumulation of detritus in the sediments. Of particular interest are the potential effects such accumulation has on sediment dynamics and lake ontogeny. Sediment core samples were taken on a transect from the water's edge to the deepest part of the lake. Samples of surficial, intermediate and deep sediments from all water depths were analyzed for content of coarse particulate matter, organic matter, solvent-extractable humins and fulvic and humic acids. Sediments at the surface in very shallow water, sediments of intermediate depth in the deep littoral zone, and sediments at all depths in the deepest waters contained the greatest concentrations of organic matter. Furthermore, those organic compounds were shown by spectrophotometric characterization to be old and probably very refractory. The observed occurrence of sedimentary detrital carbon is explained in terms of hypothesized synergistic effects of increasing production and succession of littoral vegetation, differential decomposition rates controlled by properties of both the substrate and the microenvironment and the influence of water movements and basin morphology on sediment erosion and deposition. (Author's abstract)
W86-00643

CHEMICAL COMPOSITION OF RIVER SEDIMENTS FROM THE INDIAN SUB-CONTINENT,

Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
V. Subramanian, L. Van 't Dack, and R. Van Grieken.
Chemical Geology, Vol. 48, No. 1/4, p 271-279, March, 1985. 3 Fig, 5 Tab, 16 Ref.

Descriptors: *River sediments, *Chemical composition, *Indian subcontinent, Sediments, Weathering, Watersheds, Geology, Catchment areas.

River sediments from all of the major drainage basins (except the Indus) in the Indian sub-continent were collected and analysed by thin-film X-ray fluorescence technique (XRF) to determine their chemical composition. On the basis of analysis of more than 120 samples, average chemical compositions of river-borne sediments from the Indian sub-continent have been calculated. Also, average concentration values for sediments from each of the river basins, and the sub-continent average and the inter-basin differences are discussed in relation to weathering processes in the drainage basins. Comparisons have been made with the chemistry of sediments from the Bay of Bengal (which receives the bulk of sediments delivered by Indian rivers). The observations are discussed in the light of average chemical composition of world-river sediments and the world surface rock exposed for continental weathering. (Author's abstract)
W86-00771

ECONOMICS OF EROSION CONTROL IN A SUBTROPICAL WASTERSHED: A DOMINICAN CASE,

Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
A. Veloz, D. Southgate, F. Hitzhusen, and R. Macgregor.
Land Economics, Vol. 61, No. 2, p 145-155, May, 1985. 5 Tab, 24 Ref.

Descriptors: *Erosion control, *Dominican Republic, *Soil conservation, *Developing countries, Economic aspects, Land development, Regional development, Public policy, Land use, Reservoir silting.

The economics of a soil conservation project for the watershed of the Valdesia hydroelectric dam, Dominican Republic, were analyzed in terms of private-level and social level costs and benefits, and the results interpreted in relation to the general problem of protecting soils in Third World countries. Land use and management were assumed to be guided by procedures judged by many specialists to be appropriate to the Dominican Republic; land was classified into four classes based on slope, with different procedures specified for each slope class. If the land managment guidelines were followed, it was estimated that the sedimentation rate (output) would drop 86%. It was calculated that a 25% reduction in erosion would extend the life of the hydroelectric project by 6 yr, from 19 to 25 yr. The private-level analyses have limited precision, but they indicate that some farmers would have little or no cost, and possibly some gain, from using land management measures. However, conversion of land from traditional agriculture to a more soil-conserving use does not seem to be in the private interest of many groups of farmers. Analysis of on-site impacts using a social accounting stance suggests that implementation of soil-conserving practices throughout the Valdesia reservoir catchment might satisfy the Hicks-Kaldor efficiency test. The conclusion that net social welfare would be improved by reducing erosion is reinforced by incorporating the external benefits of soil conservation into the evaluation. Lack of information, insecurity of land tenure, and currency valuation problems are among the factors accounting for lack of widespread adoption of soil conservation by people in this watershed. Ultimately, making a constructive change (including reduction of population growth) in the lives of the inhabitants of areas like the Valdesia watershed is probably the only way to contain environmental damage. (Rochester-IVI)
W86-00894

BANK-EROSION PROCESSES IN A COOL-TEMPERATE ENVIRONMENT, ORWELL LAKE, MINNESOTA,

North Dakota Univ., Grand Forks. Dept. of Geology.
J. R. Reid, Jr.
Geological Society of America Bulletin, Vol. 96, No. 6, p 781-792, June, 1985. 17 Fig, 4 Tab, 49 Ref.

Descriptors: *Bank erosion, *Orwell Lake, *Minnesota, Reservoirs, Sheet erosion, Mass wasting, Slope degradation, Thaw failure, Sublimation, Interstitial ice, Rain, Storms, Mudflows.

Orwell Lake, in west-central Minnesota, is a flood-control, water-management reservoir first impounded in 1953. Subsequent concern about erosion of the shoreline and a lack of knowledge of slope-erosion processes in this part of the upper Midwest prompted this study to identify and quantify the processes there. The processes were measured at selected sites between June 1980 and June 1983. Erosion of the banks is predominantly by thaw failure and secondarily by rainsplash and sheetwash. In winter, the upland surface adjacent to the lake freezes to a depth of between 1 and 2 m, depending on surface temperature, snow cover, and distance from exposed banks. In late winter, soil aggregates, released by the sublimation of interstitial ice within the banks, begin to accumulate at the base of the slopes, often veneering snowbanks. As soon as thaw begins, slab failure of bank sediment is followed by mudflows and earthflows. Thaw failure at Orwell Lake in the spring of 1982 accounted for 89% of the erosion (824 Mg); the following spring, 78% (746 Mg). Such slope failure is most intense along north-facing banks and considerably less intense on south-facing banks, where more effective desiccation and sublimation reduce soil-moisture content. Summer rainsplash and sheetwash were responsible for 11%-22% of the total erosion, amounting to 102 Mg in 1981 and 208 Mg in 1982. Although rainsplash is the most consistent process during summer, the occasional storm during which rainwash occurs causes greater total erosion. Erosion by rain increased in each of the three summers, largely because of increased precipitation. Infrequent massive deep-slip failures (slumps) have occurred at the east end of the lake where a buried clay-rich unit is stratigraphically and topographically positioned to favor such failures. Drought years followed by heavy spring rains probably will result in additional deep-slip slope failures. (Author's abstract)
W86-00898

2K. Chemical Processes

MODEL OF SULPHATE CONCENTRATION IN A SMALL STREAM IN THE HARP LAKE CATCHMENT, ONTARIO,

Oslo Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-00629

FACTORS CONTROLLING MASS LOSS AND NITROGEN DYNAMICS OF PLANT LITTER DECAYING IN NORTHERN STREAMS,

Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
J. M. Melillo, R. J. Naiman, J. D. Aber, and A. E. Linkins.
Bulletin of Marine Science, Vol. 35, No. 3, p 341-356, November, 1984. 13 Fig, 4 Tab, 41 Ref. NSF grants DEB-80-05081, DEB-81-05677 and DEB-82-07055.

Descriptors: *Nitrogen, *Detritus, *Decomposition, *Streams, Water temperature, Nutrients, Dissolved oxygen, Lignin, Anaerobic conditions, Aerobic conditions, Microorganisms.

In this paper the influences of initial litter quality, exogenous nutrient supply, temperature and oxygen tension on decay rates and nutrient immobilization potentials of plant litter materials decomposing in northern streams are considered. A new method of estimating nitrogen and phosphorus immobilization potentials in decaying litter is reviewed, and the mechanisms responsible for nitrogen immobilization are discussed. Initial litter quality is the dominant factor that influences decay rate. Materials rich in nitrogen and poor in lignin generally decay most rapidly. Addition of nitrogen and/or phosphorus to the water often results(s) in increased decay rate as does elevation of water temperature. While low oxygen tension retards the decay of lignin and related compounds, it is not clear that low oxygen tension slows the rate of decay of more labile compounds. Initial litter quality is also the dominant factor that influences nitrogen immobilization potential. Materials poor in both nitrogen and lignin generally have the highest immobilization potentials. Addition of nitrogen to the water increases the immobilization potential of a litter material. Plant litter decomposing under anaerobic conditions immobilizes less nitrogen than the same litter decomposing under aerobic conditions. And, all other conditions being equal, temperature changes will influence nitrogen immobilization rate but not its maximum amount. The amount of nitrogen directly associated with microbial biomass makes up only a small fraction of the total nitrogen mass in decomposing litter. Microbes appear to be important agents in the nitrogen immobilization process on decaying litter. The microbes produce exoenzymes which in turn cause the degradation of large molecules such as polyphenolics and lignins. Some of these degradation products, such as the 'reactive phenolics,' recondense with nitrogen containing compounds. The degradation-recondensation cycle continues throughout litter decay, with the ultimate product being nitrogen-rich humic substances. (Author's abstract)
W86-00637

ALTERATION OF MICROBIAL METABOLIC ACTIVITIES IN ASSOCIATION WITH DETRITUS,

North Carolina Univ. at Morehead City. Inst. of Marine Sciences.
H. W. Paerl.
Bulletin of Marine Science, Vol. 35, No. 3, p 393-408, November, 1984. 8 Fig, 1 Tab, 56 Ref.

Descriptors: *Detritus, *Microorganisms, *Metabolism, Microbial degradation, Microhabitats, Redox gradient, Protozoa, Invertebrates, Nutrients, Microzones.

Detritus serves as a microhabitat, or microzone, hosting redox gradients, altered microbial metabolism and associated biochemical nutrient transformation processes qualitatively and quantitatively distinct from the ambient planktonic environment. Through the application of tetrazolium redox indicator salts, microautoradiography and microelectrode analyses, it has shown that distributions of microbial communities and their extracellular deposition products on detrital as well as non-detrital submersed surfaces are patchy in nature, both in terms of physical distribution and associated metabolism. This patchiness promotes the development of steep redox gradients, which in turn lead to diverse microhabitats in which microorganisms, protozoans and invertebrates, all having narrow environmental tolerances, can reside. The compact nature of gradients helps promote diffusive exchange of metabolites, gases and nutrients, thereby maintaining community diversity and structural stability of microzones. Microzones also harbor specific nutrient transformation processes (i.e., nitrogen cycle N2 fixation, ammonification, nitrification and denitrification) which may otherwise be unfavorable or inhibited in ambient waters. The promotion, regulation and maintenance of specific nutrient transformation reactions in microzones are all implicated in determining nutrient availability and trophic states of affected aquatic systems. (Author's abstract)
W86-00639

CHEMICAL CHARACTERIZATION OF ESTUARINE COLLOIDAL ORGANIC MATTER: IMPLICATIONS FOR ADSORPTIVE PROCESSES,

Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 2L.
W86-00640

SPATIAL AND TEMPORAL COUPLING OF NUTRIENT INPUTS TO ESTUARINE PRIMARY PRODUCTION: THE ROLE OF PARTICULATE TRANSPORT AND DECOMPOSITION,

Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2L.
W86-00642

ANALYSIS OF PRECIPITATION CHEMISTRY DATA FROM ALASKA,

National Oceanic and Atmospheric Administration, Rockville, MD. Air Resources Lab.
U. Dayan, J. M. Miller, W. C. Keene, and J. N. Galloway.
Atmospheric Environment, Vol. 19, No. 4, p 651-657, 1985. 5 Fig, 3 Tab, 28 Ref.

Descriptors: *Chemistry of precipitation, *Acid rain, *Alaska, Poker Flat, Point Barrow, Path of pollutants, Acidity, Polar regions, Sulfuric acid, Air trajectories.

The chemical composition of precipitation collected at Poker Flat, Alaska and at Point Barrow, Alaska was evaluated in conjunction with backward air trajectories to characterize the long-range transport of acidic materials to central Alaska. Volume weighted mean concentrations of major chemical constituents characterized the composition and acidity of precipitation associated with air parcels which arrive at Poker Flat from three major source regions, the Pacific Ocean, local continental and the Arctic. Long-range trajectories from the south-west predominated during the spring and early summer. These air flow patterns originated in mid-latitudes and generated precipitation with moderate acidities (H(+) = 9.9 microeq/l). Weak flows, suggesting local airmasses, were important sources of precipitation during mid

summer. Local storms corresponded to higher acidities (H(+) = 12.7 micro-eq/l). During the late summer and early autumn, precipitation events were frequently associated with northerly flows and lower acidities (H(+) = 7.8 micro-eq/l). H2SO4 was the most important source of acidity contributing, on a volume weighted basis, between 46 and 80% of free H(+) in all samples. The higher concentration of SO4(2-) relative to H(+) in Arctic storms suggests long distance transport and neutralization of anthropogenic H2SO4 from the Polar region. Concentrations of excess SO4(2-) measured in precipitation from Alaska were greater than those measured in precipitation from Greenland and less than those measured in precipitation from the Yukon of Canada. (Author's abstract)
W86-00659

EFFECT OF GROUNDWATER ON SOIL FORMATION IN A MORAINAL LANDSCAPE IN SASKATCHEWAN,

Saskatchewan Univ., Saskatoon. Saskatchewan Inst. of Pedology.
For primary bibliographic entry see Field 2F.
W86-00670

DENSITY OF PRECIPITATION CHEMISTRY NETWORKS,

Kozponti Cegkorfizikai Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 7A.
W86-00684

EFFECTS OF STORAGE ON THE COMPOSITION OF MAIN COMPONENTS IN RAINWATER SAMPLES,

Royal Netherlands Meteorological Inst., De Bilt.
T. B. Ridder, T. A. Buishand, H. F. R. Reijnders, M. J.'t Hart, and J. Slanina.
Atmospheric Environment, Vol. 19, No. 5, p 759-762, 1985. 3 Tab, 9 Ref.

Descriptors: *Chemistry of precipitation, *Rain, *Sample preservation, Chemical composition, Temperature, Light.

Samples from twelve rainwater collectors in The Netherlands were stored under three different conditions: (i) in the light at room temperature, (ii) in the dark at room temperature and (iii) in the dark at 4 C. In samples stored at room temperature, considerable changes occurred in ammonium and phosphate concentrations both in the light and in the dark. Minor changes were also observed for potassium, calcium, chloride, sulfate and nitrate. Storage of rainwater samples in the dark at 4 C resulted in a satisfactory sample preservation. (Author's abstract)
W86-00717

EULERIAN MODEL FOR SCAVENGING OF POLLUTANTS BY RAINDROPS,

General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W86-00718

COMPARISON OF SEVERAL METHODS FOR THE DETERMINATION OF IRON HYDROXIDES AND ASSOCIATED ORTHOPHOSPHATES IN ESTUARINE PARTICULATE MATTER,

McGill Univ., Montreal (Quebec). Inst. of Oceanography.
For primary bibliographic entry see Field 2L.
W86-00769

TRACE-METAL CONCENTRATIONS IN SEDIMENTS FROM TWO CLOSED-BASIN LAKES, ANTARCTICA,

New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2H.
W86-00770

INFLUENCE OF PH ON THE BINDING CAPACITY AND CONDITIONAL STABILITY CONSTANTS OF ALUMINUM AND NATURALLY-OCCURRING ORGANIC MATTER,

Savannah River Ecology Lab., Aiken, SC.
D. B. Pott, J. J. Alberts, and A. W. Elzerman.
Chemical Geology, Vol. 48, No. 1/4, p 293-304, March, 1985. 4 Fig, 3 Tab, 33 Ref. DOE contract EY-76-C-09-0819, NSF grant ISP-8011451.

Descriptors: *Hydrogen ion concentration, *Organic matter, *Aluminum, Humic acid, *Binding capacity, *Stability constants, Chemical reactions, Natural waters, Acidity.

The binding of Al by reagent grade humic acid and by a natural water system of the southeastern U.S.A. was investigated with special emphasis on the influence of pH. Differentiation of 'bound' Al and 'free' Al was performed using cation-exchange resins. A thermodynamic equilibrium model, GEOCHEM, was used to correct the 'bound' Al data for uncharged hydrolysis products. Two methods of data analysis, i.e. Scatchard and Langmuir regressions, were used to estimate conditional stability constants of Al-humic acid complexes. Overall stability constants (log10 K) for aluminum humate were about 6.8 with little variation over the pH range 3-5. Al binding capacities were higher in natural waters (0.99-2.86 micro-mol Al per mg DOC) relative to reagent grade humic acids (0.33-0.86 micro-mol Al per mg DOC). Both the natural waters and humic acid samples showed significant increases in Al binding capacity when pH was increased from 3 to 4 (0.99-1.84 micro-mol Al per mg DOC and 0.33-0.79 micro-mol Al per mg DOC, respectively). The humic acid showed a much smaller increase in binding capacity when the pH was increased from 4 to 5 (0.79-0.86 micro-mol Al per mg DOC). Arguments are presented to show that Al is bound to humic acid through a single type of binding site, most probably a carboxylic functionality. (Author's abstract)
W86-00773

NITROGEN TRANSFORMATIONS AND LOSS IN FLOODED SOILS AND SEDIMENTS,

Agricultural Research and Education Center, Sanford, FL.
K. R. Reddy, and W. H. Patrick.
CRC Critical Reviews in Environmental Control, Vol. 13, No. 4, p 273-309, 1984. 8 Fig, 5 Tab, 231 Ref.

Descriptors: *Nitrogen, *Flooded soils, *Sediments, Ammonification, Nitrification, Denitrification, Volatilization, Ammonia, Diffusion, Reservoirs, Wetlands.

Nitrogen transformations that account for transport of N from flooded soils and sediments to the atmosphere are reviewed. Characteristics of flooded soils and sediments, forms, sources, and trasformations of N in the environment, and the influence of plants on N loss are reviewed, and research needs in the nitrogen loss area are identified. N loss mechanisms in flooded soils are governed by N transformations (ammonification, nitrification-denitrification, and ammonia volatilization) and transport process (NH4-N diffusion and NO3-N diffusion), and the presence of plants. Nitrification-denitrification seems to be predominant in the loss of ammonium N from sediments, whereas ammonia volatilization occurs under specialized conditions, mainly in overlying waters. The processes involved in converting organic N to gaseous end products include ammonification of organic N to ammonium N, upward diffusion of ammonium N into the aerobic surface layer, oxidation of ammonium N in the aerobic soil layer, downward diffusion of nitrate N into the anaerobic soil layer, and reduction on NO3-N to gaseous end products such as N2 and N20. Data on the rates of N transformation by the various processes indicate that N diffusion and denitrification are not limiting in controlling N loss during the nitrification-denitrification sequence. Ammonium diffusion depends on the ammonium N removal mechanisms (nitrification and ammonia volatilization) in the aerobic soil layer and floodwater to establish a concentration gradient. In shallow reservoirs and wetlands flooded with wastewater, nitrification occurs at a rapid rate in the overlying water column, and the major limiting process in the removal of nitrate N from the overlying water was diffusion of NO3-N from the water column to the underlying soil column. The most important research need is for study of volatilization losses by measuring the fluxes of NH3 from an aquatic system in relation temperature, surface wind velocity, sediment characteristics, alkalinity of the water, and biological activity in the soil-water system. (Rochester-IVI)
W86-00849

2L. Estuaries

EFFECTS OF TREATED SEWAGE EFFLUENT AND BAY-BOTTOM MUD ON GROWTH OF MARINE PHYTOPLANKTON,

For primary bibliographic entry see Field 5C.
W86-00616

BIOLOGICAL CONSEQUENCES OF ICE RAFTING IN A NEW ENGLAND SALT MARSH COMMUNITY,

New Hampshire Univ., Durham. Jackson Estuarine Lab.
M. N. Hardwick-Witman.
Journal of Experimental Marine Biology and Ecology, Vol. 87, No. 3, p 283-298, May, 1985. 7 Fig, 47 Ref.

Descriptors: *Ice rafting, *Salt marshes, *Ecological effects, New England, Mussels, Peat, Algae, Cordgrass, Growth, Mortality, Predation, Simulation, Marshes.

Ice rafting of salt marsh peat is a recurrent phenomenon in north temperate regions. This process was simulated in a northern New England salt marsh to test several hypotheses concerning the effects of peat transport from high to low intertidal heights on the growth and mortality of key sessile organisms: the ribbed mussel Geukensia demissa (Dillwyn), the fucoid alga Fucus vesiculosus L. var. spiralis (Farlow) and the cordgrass Spartina alterniflora (Loisel.). Growth rates increased when Geukensia and Fucus were transported to the lower intertidal; however, Spartina died when similarly transported. Predation pressure (primarily from Carcinus maenus L.) on Geukensia was greater when it was rafted to the lower intertidal zone than in the upper intertidal habitat and was size specific; mussels > 3.5 cm reached a size-escape from crab predation. A winter survey of dislodged mussels revealed that 72% of the mussels collected were dead and 86% had been overgrown by large Fucus plants, > 2.5 x the natural frequency of Fucus overgrowth (32%). In marsh habitats where hard substratum is rare, 91% of the Fucus were growing on Geukensia. A dislodgement experiment showed that a significantly greater percentage of Geukensia was dislodged after ice-out when Fucus was attached to the shell than those mussels without Fucus overgrowth. In the spring, a population survey conducted in the salt marsh examined densities, biomass and population structure of Geukensia, as well as densities, percent cover and biomass of Fucus. Values obtained in the foremarsh were compared to those from the peat islands recently rafted to the tidal flats. Both biomass and densities of Geukensia were similar in the two areas; however, the size-frequency distributions of the mussels were different. Since fewer large mussels, Fucus and Fucus-overgrown mussels were found on the newly transported peat islands, this pattern appears to reflect dislodgement of larger Geukensia by attached algae during ice transport. Two ice-related sources of mortality were identified for Geukensia: (1) Fucus overgrowth acted as vector for mussel dislodgement and was an indirect source of mortality; and (2) ice crushing was a direct source of mortality for non-overgrown mussels. (Author's abstract)
W86-00627

RESPONSE OF A DETRITAL FOODWEB TO EUTROPHICATION,

Marine Biological Lab., Woods Hole, MA.
For primary bibliographic entry see Field 5C.
W86-00638

CHEMICAL CHARACTERIZATION OF ESTUARINE COLLOIDAL ORGANIC MATTER: IMPLICATIONS FOR ADSORPTIVE PROCESSES,

Maryland Univ., Solomons. Chesapeake Biological Lab.
J. C. Means, and R. D. Wijayaratne.
Bulletin of Marine Science, Vol. 35, No. 3, p 449-461, November, 1984. 3 Fig, 3 Tab, 49 Ref.

Descriptors: *Colloids, *Organic matter, *Adsorption, *Estuarine environment, Particulate matter, Dissolved solids, Geochemistry, Lipids, Carbohydrates, Amino acids, Seasonal variation.

Dissolved and particulate organic matter are important components of the carbon and nitrogen cycles. Because of their surface active nature and reactivity, dissolved organic colloids are also important in many geochemical processes. The chemical nature of colloidal organic matter is an important factor in determining how it will behave in relation to other substances in the system. In the present study, colloidal organic matter (> 0.4 micro-m to 1.2 nm) collected from the Chesapeake Bay estuary over a salinity range of 2 to 22% was characterized for organic carbon (DOC), lipid (TDL), carbohydrate (TDS) and amino acids (TAA). Analysis of the biochemical constituents of colloidal organic carbon indicated that (TDS), (TAA) and (TDL) account for 35-60%, 4-13% and less than 1%, respectively, of the DOC content. The TDS fraction had a predominance of glucose and galactose while the TAA fractions showed high abundances of aspartic, glutamic, serine, threonin and glycine. Seasonal changes in the TDS and TAA levels in estuarine colloids revealed that sugars and amino acids were higher in summer than in winter, and may be related to primary and secondary productivity. Enrichment of carbohydrates and amino acids in colloidal material collected near a density boundary (pycnocline) was observed. The results of this study are discussed in the light of these biogenic polymers acting as a sorbent in the enrichment. (Author's abstract)
W86-00640

DUAL-GRADIENT CONCEPT OF DETRITUS TRANSPORT AND PROCESSING IN ESTUARIES,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
W. E. Odum.
Bulletin of Marine Science, Vol. 35, No. 3, p 510-521, November, 1984. 7 Fig, 1 Tab, 40 Ref. NSF DEB-8109674.

Descriptors: *Detritus, *Estuarine environment, Solute transport, Particulate transport, Salinity, Marshes, Stream order, Organic carbon, Dissolved solids, Particulate matter, Productivity, Aquatic plants.

The concept that organic detritus is not uniformly distributed in estuaries, but occurs principally along two gradients, the salinity axis gradient and the marsh stream order gradient is proposed. Preliminary evidence suggests that DOC and POC are distributed along these gradients in generally decreasing concentrations from the sources, river carbon in the first case and tidal marsh carbon in the second. Processing of detritus along the salinity axis gradient is due principally to physical processes such as flocculation while biological processes play a more important role along the marsh stream order gradient. The potential carbon sources for primary consumers along the marsh stream order gradient should demonstrate a shift from predominantly vascular plant detritus, benthic microalgae, and, possibly, carbon from terrestrial sources in the low order streams to phytoplankton and phytoplankton detritus in the larger streams and embayments. Large beds of submerged macrophytes such as seagrasses can introduce considerable variation in these trends in DOC and POC concentrations. All of these phenomenon are important in considerations of the relative importance of organic detritus as an energy source for estuarine consumers. (Author's abstract)
W86-00641

SPATIAL AND TEMPORAL COUPLING OF NUTRIENT INPUTS TO ESTUARINE PRIMARY PRODUCTION: THE ROLE OF PARTICULATE TRANSPORT AND DECOMPOSITION,

Maryland Univ., Cambridge. Horn Point Environmental Labs.
W. M. Kemp, and W. R. Boynton.
Bulletin of Marine Science, Vol. 35, No. 3, p 522-535, November, 1984. 6 Fig, 1 Tab, 78 Ref.

Descriptors: *Estuarine environment, *Nutrients, *Primary productivity, *Particulate transport, *Decomposition, *Patuxent River, *Maryland, Solute transport, Nitrogen, Phosphorus, Dissolved solids, Particulate matter, Plankton, Salinity, Sedimentation, Resuspension, Water temperature.

Spatial and temporal aspects of the coupling of nutrient inputs to estuarine primary production are discussed in terms of formation, transport and decomposition of particulate material in the Patuxent River estuary. Mixing diagrams of dissolved and particulate nitrogen and phosphorus (DIN, PN, DIP, PP) versus salinity indicate rapid removal of DIN and DIP with parallel formation of PN and PP in the slightly brackish (0-5%) region. However, plankton production (per sq m) tends to be inversely related to salinity between 0 and 10%. While most of the annual nutrient inputs to the Patuxent occur between December and April, peak plankton production occurs in the summer. Deposition and resuspension of particulate substances in this system are dynamic processes which decrease in a seaward direction. Regeneration of DIN and DIP from particlate decomposition in the sediments similarly decreases toward the estuary's mouth; however, highest rates are in the 5-10% region. Temporal patterns of benthic regeneration and plankton production are congruent (being generally related to temperature), and rates of sediment NH4(+) recycling represent about 60-80% of the plankton assimilative demand in the 5-10% region. On the basis of these observations a conceptual model is proposed in which annual inputs of dissolved nutrients from runoff are converted into particulate forms which are gradually transported seaward through cycles of deposition and resuspension. As temperatures rise in the summer these particulates are decomposed, releasing dissolved nutrients to the euphotic zone where they support the major annual blooms of plankton. By comparing these patterns for the Patuxent with those reported for other estuaries, it is suggested that this model may be relatively general for many coastal systems. (Author's abstract)
W86-00642

GROWTH IN BIOMASS OF BALANUS BALANOIDES YOUNG AT VARIOUS CURRENT VELOCITIES,

Akademiya Nauk SSSR, Moscow. Inst. of Evolutionary Morphology and Animal Ecology.
For primary bibliographic entry see Field 2H.
W86-00721

EFFECT OF VELOCITY OF WATER FLOW ON GROWTH OF COLONIAL HYDROIDS (HYDROZOA, THECAPHORA),

Moscow State Univ. (USSR).
For primary bibliographic entry see Field 2H.
W86-00722

COMPARISON OF SEVERAL METHODS FOR THE DETERMINATION OF IRON HYDROXIDES AND ASSOCIATED ORTHOPHOSPHATES IN ESTUARINE PARTICULATE MATTER,

McGill Univ., Montreal (Quebec). Inst. of Oceanography.
M. Lucotte, and B. d'Anglejan.
Chemical Geology, Vol. 48, No. 1/4, p 257-264, March, 1985. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Iron hydroxides, *Orthophosphates, *Particulate matter, *Estuarine environment, Minerals, Sediments, Suspended solids, Analytical methods, Phosphorus, St. Lawrence Seaway, Eastmain River Estuary, Quebec.

Five different methods commonly used for the extraction and the determination of iron hydroxides and/or the associated phosphorus held in marine seston or in sediments have been tested on single-phase minerals (goethite and apatite), on reference minerals (SO1 and SO2), and on suspended-matter samples from the St. Lawrence Estuary and from the estuary of the Eastmain River, a major James Bay affluent in northern Quebec, Canada. The citrate-dithionite-bicarbonate (CDB) procedure generally seemed to be more reproducible and more specific. The validity of the other methods respectively using as extracting reagents ammonium oxalate-oxalic acid, hydroxylamine hydrochloride, calcium nitrilotriacetic acid and acetate-tartrate is discussed. The CDB extraction is included in an analytical scheme which allows to distinguish between three fractions of phosphorus. This chemical speciation is applied to the study of P retention on Fe-hydroxides, and to its potential desorption. (Author's abstract)
W86-00769

HISTORICAL CHANGES IN SUBMERGED MACROPHYTE COMMUNITIES OF UPPER CHESAPEAKE BAY,

California Univ., Santa Barbara. Dept. of Geography.
For primary bibliographic entry see Field 2H.
W86-00828

SEASONAL CYCLES OF PHYTOPLANKTON POPULATIONS AND TOTAL CHLOROPHYLL OF THE LOWER ST. JOHNS RIVER ESTUARY, FLORIDA,

University of North Florida, Jacksonville. Dept. of Natural Sciences.
C. DeMort, and R. D. Bowman.
Biological Sciences, Vol. 48, No. 2, p 96-107, 1985. 5 Fig, 4 Tab, 18 Ref.

Descriptors: *Phytoplankton, *Chlorophyll, *Seasonal variation, *St. Johns River Estuary, *Florida, Population dynamics, Species diversity, Salinity, Phosphates, Hydrogen ion concentration, Estuarine environment.

Monthly plankton collections and water analyses were made at 7 stations along the lower 42 km of the St. Johns River Estuary (Florida) for a 2-yr period. Measurements included temperature, light extinction, salinity, dissolved oxygen, chlorophyll, nutrients, iron, copper, turbidity and pH. All of the stations exhibited major peaks in cell numbers and chlorophyll in June or July and secondary peaks in December or January. The total number of distinct population peaks decreased from 4, near the river's mouth, to 2 at the upper stations. Species diversity decreased with distance from the river's mouth, whereas, chlorophyll concentration increased. The chlorophyll concentration was correlated closely with cell counts at most stations. Population density appeared to be most closely correlated with salinity, phosphate, and pH. High N:P ratios occurred throughout the year, suggesting that phosphorus is more limiting than nitrogen in the St. Johns River system. (Author's abstract)
W86-00900

INFLUENCE OF SALINITY ON SCIRPUS AMERICANUS TIDAL MARSHES IN THE ST. LAWRENCE RIVER ESTUARY, QUEBEC,

Laval Univ., Quebec. Dept. of Civil Engineering.
J. Deschenes, and J.-B. Serodes.
Canadian Journal of Botany, Vol. 63, No. 5, p 920-927, May, 1985. 4 Fig, 1 Tab, 22 Ref.

Descriptors: *Salinity, *Tidal marshes, *Bulrushes, *St. Lawrence River estuary, *Quebec, Sodium, Aquatic plants, Marshes, Brackish waters, Estuaries.

The amount of sodium in the aboveground part of the stalks of Scirpus americanus taken at the peak of biomass is a good indicator of the amount of salinity in the waters flooding the tidal marshes of an estuary. In fresh water, the Na concentrations remain below 10,000 and then increase sharply up to 20,000 - 30,000 mg/kg in brackish waters. Even

though this plant can grow under brackish conditions, salinity has a considerable effect on the percentage of submersion it can withstand. Consequently, in the presence of saline water, the lower limit of the vegetation regresses towards the shore. In the case of fresh water, Scirpus americanus occupies the lower part of marshes up to an average of 75% of submersion, while in brackish water it extends to about 35% and then disappears when waters are more saline. (Author's abstract)
W86-00902

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

LENGTH AND SLOPE EFFECTS ON RUNOFF FROM SODIUM DISPERSED, COMPACTED EARTH MICROCATCHMENTS,

Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
S. R. Evett, and G. R. Dutt.
Soil Science Society Journal of Americal, Vol. 49, No. 3, p 734-738, May-June, 1985. 3 Fig, 3 Tab, 22 Ref. USDA grant 82-CRSR-2-2005.

Descriptors: •Water harvesting, •Runoff, •Microcatchments, •Compacted earth, •Slope, •Downslope length, Salts, Rainfall intensity, Model studies, Salinity, Storms, Soil permeability.

A study was conducted on the effects of slope and downslope length on daily runoff and erosion from earthen microcatchments treated with sodium salt and compacted. Two replicates of a two-factor experiment, including 1, 5, 10, and 15% slopes and 3- and 6-m lengths, were built on a gravelly sandy clay loam (mixed mineralogy) using 11.2 t/ha of NaCl mixed into the surface 2 to 5 cm of soil followed by compaction with a 6-t roller after a heavy rain. Total runoff was measured volumetrically after each of 18 storms. Both slope and length had effects on runoff significant at the 0.1% probability level but the effect of rainfall intensity was not significant. The best fit linear model of runoff explained about 98% of the variability in runoff on individual plots for individual storms but explained no differences in runoff among treatments. A nonlinear model incorporating slope and length accounted for about 96% of the variability in average total runoff among treatments. This model shows that the important differences in runoff among treatments can be explained by slope and length alone for these conditions. Only a minor salinity problem but slight to moderate permeability problems might be expected. No apparent problems have arisen in 12 yr of grape and fruit tree cultivation in a water harvesting system using this type of catchment on the same soil. (Moore-IVI)
W86-00705

WATER FOR SALT LAKE CITY,

Salt Lake City Dept. of Public Utilities, UT.
W. E. Evensen.
Public Works, Vol. 116, No. 6, p 102-104, June, 1985. 2 Fig.

Descriptors: •Salt Lake City, •Utah, •Water supply development, •Water conveyance, Water mains, Tunnel construction, Reservoir construction, Financing.

Salt Lake City, Utah, is the major trading center of the Intermountain region of the western United States. In recent years it has experienced a population decline concomitant with an increase in demand for water from the city supply system. This demand resulted from expansion of non-residential developments, including office buildings and hotels. Today's demand of about 96,000 acre-ft is met through four treatment plants located on canyon streams leading from the Wasatch Mountains. Beginning in 1984, additional water became available from the Jordan Aqueduct portion of the Central Utah Project. To take advantage of this supply a large connecting supply line was needed to bring the water to the city's west side. Since 1976, a capital improvement program has been underway to provide the connection to the aqueduct and a 12 million gallon terminal, the Victory Road Reservoir. Numerous engineering challenges were presented by different phases of this project, including dealing with seepage from beneath the reservoir site, tunneling beneath a major railway line, and evaluation of the hazard connected with major water mains crossing a fault line. The city's former cash-only financing methods had to be changed to obtain $25 million for funding the project. In addition to the reservoir, which is 280 ft in diameter, 30 ft deep, and completely buried, major 48 inch and 36-inch supply lines, major 30- and 24-inch branches, and tie-ins to existing distribution systems were constructed. (Rochester-IVI)
W86-00809

BULK SUPPLY SCHEME OF THE MID SOUTHERN AND NORTH SURREY WATER COMPANIES,

North Surrey Water Co., Staines (England).
P. O. Packham, and E. G. Moss.
Journal Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 155-168, April, 1985. 5 Fig, 1 Append.

Descriptors: •Water supply development, •England, •Thames River, Organizations, Pipelines, Water transport, Costs, Economic aspects, Administrative agencies.

The Mid Southern Water Company (England), which serves an area undergoing rapid population increase due to 'overspill' from the city of London, successfully increased its capacity by cooperating with the North Surrey water company in a bulk supply scheme. Water is obtained from the upper Thames at the North Surrey's Egham plant, and pumped to a new reservoir constructed at Surrey Hill, from which water is distributed into the existing Mid Southern network. To carry water from Egham to Surrey Hill, a 900 mm trunk main 20.5 km long was constructed. Project costs were (million pounds sterling): Egham works, new pumphouse and uprating of treatment plant, 1.3; trunk main, 4.6; and Surrey Hill Reservoir (excluding outlet main), 1.3. A bulk supply of up to 22 million liters/day can be obtained from the new system, which has been averaging 18 million liters/day since opening in June of 1982. Additional development of Egham Works in the future will bring the bulk supply up to 75 million liter/day. This project was administratively complex because it involved two separate water companies, plus water under the control of the Thames Water Authority. The history of administrative and legal arrangements and discussions of cost sharing are detailed in this paper. (Rochester-IVI)
W86-00835

3F. Conservation In Agriculture

CHEMICAL AND STUBBLE-MULCH FALLOW INFLUENCES ON SEASONAL SOIL WATER CONTENTS,

Agricultural Research Service, Sidney, MT. Northern Plains Soil and Water Research Center.
D. L. Tanaka.
Soil Science Society of America Journal, Vol. 49, No. 3, p 728-733, May-June, 1985. 5 Fig, 1 Tab, 25 Ref.

Descriptors: •Conservation tillage, •Soil water content, •Fallow, Seasonal variation, Chemical fallow, Stubble mulch fallow, Water conservation, Precipitation frequency.

A study was conducted in the northern Great Plains to determine the effect of chemical and stubble-mulch fallow of a Williams loam (fine-loamy mixed, Typic Argiborolls) on soil water contents during 14- and 21-month fallow periods. Soil water contents to a depth of 1.70 m measured by use of the neutron-scatter technique for two 14- and three 21-month fallow periods. The amount of surface residue after harvest range from 0.6 to 3.6 Mg/ha during the study. Chemical fallow maintained more surface residue than stubble-mulch fallow, but no significant differences in soil water contents to 1.70-m soil depth occurred between the treatments. Gain in soil water occurred after harvest and over the first winter with soil water loss generally occurring during summer for 14- and 21-months of fallow. No gain in soil water contents occurred over the second winter when chemically fallowed for 21-months. Precipitation frequency and distribution may be just as important as quantity and position of surface residue for chemicals fallow to effectively store more soil water than stubble-mulch fallow. (Author's abstract)
W86-00704

SEEPAGE-LIMITATION OPTIMIZATION OF THE SHAPE OF AN IRRIGATION CHANNEL BY THE INVERSE BOUNDARY-VALUE PROBLEM METHOD,

N. B. Il'inskii, and A. R. Kasimov.
Fluid Dynamics, Vol. 19, No. 3, p 404-410, May-June, 1984. 6 Fig, 13 Ref.

Descriptors: •Irrigation practice, •Channel morphology, •Seepage, •Inverse boundary-value method, Soil water, Backwater, Capillarity, Evaporation, Infiltration, Drainage.

Equations are presented for finding the optimal cross-sectional shape for an irrigation channel to minimize seepage loss. Seepage was assumed to be one-dimensional, steady, and to satisfy Darcy's law. Capillarity, infiltration, and evaporation were ignored in the calculations, which account for seepage without backwater, seepage with backwater (ie, when the velocity at infinity vanishes), seepage into a horizontal drainage layer, and seepage into a water-bearing layer. For channels with unit cross-sectional area, the seepage without backwater from the optimal channel is 5.67% smaller than for a rectangular channel, and the reduction compared to a trapezoidal channel is 6.2%. In the case of an optimal channel through a permeable layer, the head in the underlying horizontal permeable layer has a profound effect on seepage flow rate of the optimal channel. (Rochester-IVI)
W86-00869

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

MONITORING URBAN WATERWAYS TO REDUCE FLOOD DAMAGE AND ENSURE PUBLIC SAFETY,

Canadian Applied Technology, Toronto (Ontario).
E. House.
Water and Pollution Control, Vol. 123, No. 3, p 22-23 and 59, May/June, 1985.

Descriptors: •Flood control, •Forecasting, •Toronto, •Ontario, Monitoring, Rivers, Flow, Telemetry, Measuring equipment, Remote sensing.

The primary objective of the Metropolitan Toronto and Region Conservation Authority's (MTRCA's) flood forecasting center is to provide the public, business and local municipalities with sufficient advanced warning of possible flooding events, along with the magnitude and the duration of the hazard. In order to provide the most accurate and timely forecasts, the urban hydrologist must act quickly to collect the most historical and current information for each river system. This information is used in conjunction with hydrologic knowledge of each river system, such as the ever changing information on watershed land use, its physiography, stream flow and the state of flood control facilities. The MTRCA monitors the river systems' water level or flow, snow pack information, soil conditions and weather information such as the duration and amount of precipitation, temperature, relative humidity, wind speed and direction. The MTRCA has identified 33 major flood prone sites and 200 minor flood prone sites on its river systems. Located at stragetic sites, usually

upstream from a flood prone site, are small shelters called gauging houses which measure the river's water level in order to determine flow. The use of logging as well as telemetering equipment enables constant contact to be maintained with the measuring stations. (Baker-IV)
W86-00687

CHANGES IN SOIL CARBON AND NITROGEN DUE TO IRRIGATION DEVELOPMENT IN NEBRASKA'S SANDHILL SOILS,
Nebraska Univ.-Lincoln. Dept. of Agronomy.
For primary bibliographic entry see Field 6G.
W86-00703

DEVELOPING AN EFFECTIVE STORM DRAINAGE MAINTENANCE PROGRAM,
Fort Collins, CO.
M. Engemoen, M. Mercer, and R. E. Krempel.
Public Works, Vol. 116, No. 6, p 84-88, June, 1985.

Descriptors: *Maintenance, *Drainage systems, *Storm drains, *Fort Collins, *Colorado, Management planning, Land use planning, Channels.

Maintenance of storm drainage ways has lagged behind other public works management practices. Recent experiences in Fort Collins, Colorado, demonstrate both how neglected channels can become a problem and how an organized maintenance effort can achieve a solution. Maintenance of storm drainage facilities first involves planning, in which problems, needs, and opportunities are evaluated and goals and objectives are specified. Second, the plan must be implemented through establishment of policies, programs, and priorities. Physical upkeep is not the only function required. Organizational and financial arrangements must be designed to achieve the objectives. Three examples that go beyond physical upkeep and incorporate maintenance aspects into the overall stormwater programs are (1) design criteria, which formalize preventive maintenance through good design, (2) basin master planning, and (3) open space/land use considerations. The final stage in maintenance is implementation, evaluation, and verification of effectiveness of the program, in which three key issues are (1) communicating with the public, (2) maintaining quality of maintenance efforts, and (3) being creative in both physical and management aspects of drainage maintenance. (Rochester-IVI)
W86-00806

PROPORTIONAL WEIRS FOR STORMWATER POND OUTLETS,
EGC-Southwell, Inc., Englewood, CO.
For primary bibliographic entry see Field 8A.
W86-00887

4B. Groundwater Management

HYDROLOGIC AND VEGETATIONAL CHANGES RESULTING FROM UNDERGROUND PUMPING AT THE CYPRESS CREEK WELL FIELD, PASCO COUNTY, FLORIDA,
Southwest Florida Water Management District, Brooksville.
For primary bibliographic entry see Field 6G.
W86-00899

4C. Effects On Water Of Man's Non-Water Activities

MODELING THE CUMULATIVE EFFECTS OF FOREST PRACTICES ON DOWNSTREAM AQUATIC ECOSYSTEMS,
Kock and Associates, Wenatchee, WA.
For primary bibliographic entry see Field 6G.
W86-00651

DESTRUCTION OF WATER RESOURCES - THE MOST CRITICAL ECOLOGICAL CRISIS OF EAST ASIA,
International Union for Conservation of Nature and Natural Resources, New Delhi (India).
N. D. Jayal.
Ambio, Vol. 14, No. 2, p 95-98, 1985. 3 Fig, 4 Ref.

Descriptors: *Water resources development, *East Asia, *Water pollution effects, *Hydrological cycle, Environmental effects, Planning, Water management, Drought, Water conservation.

The destruction of the life-support systems of the poor and marginal populations in the East Asian region is the real cause of growing poverty and deprivation that in turn is related to a whole spectrum of economic and social problems. The destruction of water resources is increasingly becoming the most severe threat to survival in the countries of the south. This destruction is arising in two ways: by the disruption of the hydrological cycle on which the renewability and sustained availability of water depends, and by the pollution of water systems with industrial and urban wastes. Conventional meanings of water conservation reflect the engineering approach to handling of the natural-resource crises. Water conservation in this approach is reduced to impounding river water in large dams, to building large networks of concrete-lined canals. This water conservation strategy does not solve the water crisis of the marginal populations. A water conservation strategy that aims at being sustainable needs to be based on ecological principles. It has to recognize that water resources get destroyed either by excessive withdrawals of natural resources from an ecosystem or by excessive additions of wastes into an ecosystem. Conservation of water in Asian societies means avoiding the destructive and distorted use of resources. It means respecting essential ecological processes like the hydrological cycle and the difference between vital and non-vital needs. (Baker-IVI)
W86-00666

GOLD-MINING EFFECTS ON STREAM HYDROLOGY AND WATER QUALITY, CIRCLE QUADRANGLE, ALASKA,
Alaska Univ., Fairbanks. Inst. of Water Resources.
D. M. Bjerklie, and J. D. LaPerriere.
Water Resources Bulletin, Vol. 21, No. 2, p 235-243, April, 1985. 3 Fig, 4 Tab, 8 Ref. EPA project 808340-01.

Descriptors: *Gold mining, *Hydrology, *Water pollution effects, *Circle Quadrangle, *Alaska, Placer mining, Streams, Subsurface water, Chemical properties, Water level, Stream flow, Specific conductance, Dissolved oxygen, Mine drainage, Sediments.

Effects of placer mining on the hydrology and water quality of several interior Alaska streams were studied as part of a project on the impacts of placer mining on stream ecosystems. Surface and subsurface waters were analyzed in the field for conductivity, pH, temperature, alkalinity, total and calcium hardness, iron, copper, manganese, ammonia-N, nitrate-N, nitrite-N, settleable solids, and turbidity. Total, nonfiltrable, and filtrable residues were determined in the laboratory. In the streams placer mining increased turbidity, settleable solids, nonfiltrable and filtrable residues and total iron. Surface and subsurface water levels, as measured in wells driven in the stream beds, were correlated with stream flow. Fine sediment deposited on stream beds in mined drainages reduced the hydraulic contact between the surface and subsurface waters of the stream and caused the piezometric water level to be below the surface water level of the mined streams. This resulted in higher specific conductance and significantly lower dissolved oxygen concentrations in the subsurface waters of mined streams compared to their surface waters. No significant differences were found for any water quality characteristics comparing surface to subsurface waters for the unmined streams. (Author's abstract)
W86-00785

4D. Watershed Protection

USING SIMULATION TO ASSESS THE IMPACTS OF CONSERVATION TILLAGE ON MOVEMENT OF SEDIMENT AND PHOSPHORUS INTO LAKE ERIE,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
D. B. Beasley, E. J. Monke, E. R. Miller, and L. F. Huggins.
Journal of Soil and Water Conservation, Vol. 40, No. 2, p 233-237, March/April, 1985. 1 Fig, 6 Tab, 11 Ref.

Descriptors: *Erosion control, *Lake Erie, *Conservation tillage, *Sediment transport, *Phosphorus, Simulation, Nutrients, Sediment yield, Agricultural watersheds, Tillage.

Attempts were made to develop and test a methodology based on the ANSWERS model for making basin wide predictions of sediment and nutrient yields using a small, stratified sample; to provide a means of quantifying the impacts that various conservation tillage applications could have on overall sediment and P yields to Lake Erie; and to study the effects of different sample sizes on the predicted basin responses. Eighteen sample watersheds, a 1.0% sample of the total Lake Erie basin, represented the major soil groups in the area of study. Land in the study area was typically flat to rolling, requiring both subsurface and surface drainage. The cropland, between 65 and 80% of the area, is productive. Typical tillage management included fall moldboard plowing and spring disking. But use of the chisel plow and several conservation tillage practices is increasing. Soil erosion rates and associated P yields in the western basin are rather small compared with those in many highly productive agricultural areas. The basic problems are that the soils typically have a high clay content and thus a large capacity for P transport. The receiving body, Lake Erie, is already eutrophic. The simulation concluded that the reduction achievable in phosphorus and sediment transport from conservation tillage only probably would not meet the international agreement goals. The roughly 1,100 t/yr reduction required of the study area could only be met with a greater than 50% change over to no-till. A realistic, short-term expectation might be a 50% switch to chisel plowing resulting in a reduction of 831 t/yr if the entire basin is treated or of 587 t/yr if only group 2 soils were treated. (Baker-IVI)
W86-00650

WATERSHED PLANNING FOR ACID MINE DRAINAGE ABATEMENT,
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Water Resources Bulletin, Vol. 21, No. 2, p 253-263, April, 1985. 13 Fig, 1 Tab, 10 Ref.

Descriptors: *Acid mine drainage, *Watershed management, *Water pollution control, *Blacklick Creek Watershed, *Pennsylvania, Planning, Priorities, Abandoned mines, Water quality, Land use, Mapping.

Acid drainage from abandoned mines is a widespread problem in old mining regions. Agencies seeking to abate it face the prospect of dealing with hundreds of potential abatement projects, stretching decades into the future. A systematic regional analysis is necessary to establish locations, objectives, priorities, and phasing of such projects. The U.S. Bureau of Mines developed a novel procedure for abatement planning in the 420 square mile Blacklick Creek Watershed in Pennsylvania. The plan sought to direct abatement projects toward pollution sources where degradation was worst and adverse effects greatest. It established abatement priorities by comparing the 'supply' of sources to be reclaimed (the degrees of old mines' water quality degradation) with the 'demand' for abatement to be done (the natural and cultural values represented by the region's demography, land use and other non-mining characteristics). Matrices were used to define the relationships among mining and non-mining factors; maps were developed to show the geographic distribution of the conclusions. The locations, priorities, and phasing of abatement objectives shown on the maps should provide guidance for any abatement effort,

no matter what type of technology is applied to achieve the objectives. Over the many years in which abatement projects are to be performed in the Watershed, the plan can be used to define, coordinate, and establish priorities for the projects in a manner that can result in maximum abatement benefits from the application of limited funds. (Author's abstract)
W86-00787

ECONOMICS OF EROSION CONTROL IN A SUBTROPICAL WASTERSHED: A DOMINICAN CASE,

Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 2J.
W86-00894

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

EFFECT OF SULFITE DECHLORINATION ON THE ACCUMULATION OF WATERBORNE LEAD BY RAINBOW TROUT (SALMO GAIRDNERI),

Canada Centre for Inland Waters, Burlington (Ontario).
P. V. Hodson, and D. J. Spry.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 4, p 841-844, April, 1985. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Bioassay, *Lead, *Sulfites, *Dechlorination, *Trout, Bioaccumulation, Heavy metals, Organic matter, Water treatment, Charcoal filtration.

Chlorine can be removed from laboratory water supplies by reduction with sodium sulfite, but sulfite complexation of metals may bias aquatic toxicity tests. The effect of waterborne sulfite on the accumulation of waterborne lead by rainbow trout (Salmo gairdneri) was tested. After 96 h, the blood lead levels of trout exposed to both 100 micro-g lead/L and 440 micro-g sodium sulfite/L were lower than those exposed to lead alone. The highest level of sodium sulfite having no effect on blood lead was 20 micro-g/L. The addition of 200-300 micro-g sodium sulfite/L to the water supply after charcoal filtration removed residual chlorine levels rapidly and completely. This reaction, and other possible reactions with organic matter, always reduced measureable sulfite levels to less than 1 micro-g/L (limit of detection), a level much lower than those tested. Hence, sulfite dechlorination should not interfere with metal bioassays. (Author's abstract)
W86-00615

OLIGOCHAETE COMMUNITIES OF THE SUBLITTORAL AS INDICATORS OF LAKE GENEVA EUTROPHICATION,

Conservation de la Faune, Saint-Sulpice (Switzerland).
C. Lang.
Archiv fur Hydrobiologie, Vol. 103, No. 3, p 325-340, May, 1985. 3 Fig, 4 Tab, 28 Ref.

Descriptors: *Oligotrophic lakes, *Eutrophication, *Lake Geneva, *Switzerland, *Oligochaetes, Population dynamics, Water pollution effects, Sublittoral zone, Pollution indicators, Bioindicators, Monitoring.

The oligochaete communities, mostly tubificid and lumbriculid worms, were sampled in 1982 in the sublittoral area (40 m deep) on the northern coast of Lake Geneva (Switzerland) and results were compared to those from a 1977 study. Primary production of phytoplankton in the lake and organic inputs by the Rhone River (70% of total input) were lower before the 1977 survey than before the 1982 survey. The absolute density of all the oligochaetes, of mesotrophic and of eutrophic worm species was higher in 1982 than in 1977, even if differences due to the more efficient sampling were eliminated. In both surveys, the absolute density of oligotrophic species was the same. These species were less abundant than mesotrophic or eutrophic species. The relative density of mesotrophic worm species was higher in 1982 than in 1977, perhaps due to the effect of the season. The percentage of oligochaete communities typical of mesotrophic conditions, i.e. wherein relative density of mesotrophic species was equal or superior to 50%, was higher in 1982 than in 1977. In 1982, the mean biomass of the macrobenthos per area decreased according to the increase in distance from the inflow of the Rhone River. The proportion of the oligochaete communities typical of oligotrophic, of mesotrophic and of eutrophic conditions encountered during the 1977 and the 1982 surveys was used to indicate the probability for Lake Geneva to be in a given trophic state. (Baker-IVI)
W86-00624

FLUORIMETRIC DETERMINATION OF TRACE HYDROGEN PEROXIDE IN WATER WITH A FLOW INJECTION SYSTEM,

Texas Tech Univ., Lubbock. Dept. of Chemistry.
H. Hwang, and P. K. Dasgupta.
Analytica Chimica Acta, Vol. 170, No. 2, p 347-352. 3 Fig, 17 Ref. U.S. EPA grant R810894-010.

Descriptors: *Fluorometry, *Hydrogen peroxide, *Flow injection, Hydroxyphenylacetic acid, Peroxidase, Ammonia, Water analysis, Chemical analysis, Chemistry of precipitation.

Although many selective spectrophotometric and electrochemical methods for determination of hydrogen peroxide have been described, the requisite sensitivity for applications to precipitation and cloudwater limits the approaches to the more sensitive luminescence methods. A fluorimetric flow-injection procedure with a single reagent solution containing p-hydroxyphenylacetic acid, peroxidase and ammonia permits the determination of aqueous hydrogen peroxide in the range 10 to the -8 power to 10 to the -4 power M; 30-60 samples can be processed per hour. The method exhibits a wide linear range and is insensitive to sample pH within the range 2-6. After 48 h the determination of very low concentrations was impaired. (Collier-IVI)
W86-00645

METHOD FOR AQUATIC MULTIPLE SPECIES TOXICANT TESTING: ACUTE TOXICITY OF 10 CHEMICALS TO 5 VERTEBRATES AND 2 INVERTEBRATES,

Environmental Research Lab.-Duluth, MN.
G. L. Phipps, and G. W. Holcombe.
Environmental Pollution (Series A), Vol. 38, No. 2, p 141-157, 1985. 4 Tab, 19 Ref.

Descriptors: *Toxicity, *Testing procedures, *Fish, *Invertebrates, Organic compounds, Water pollution effects, Crayfish, Snails, Chlorinated hydrocarbons.

A more efficient method was sought for conducting aquatic acute toxicity tests so the resulting data would be directly comparable between species. This method produced LC50 data on several species at a fraction of the time and money it takes to produce them by using individual tests for each species. Species tested included fathead minnows, goldfish, channel catfish, bluegill, rainbow trout, crayfish, snails, and chinook salmon. Compounds tested included pentachlorophenol, 2-chloroethanyl, 2,4-pentanedione, hexachloroethane, alpha-bromo-2',5'-dimethoxyacetophenone, benzaldehyde, 1,3-dichloro-4,6-dinitrobenzene, dursban, sevin, and cadmium chloride. The method as developed permits acute toxicity tests to be conducted on several species in different chambers of the same exposure tank. It allows an easy determination of the most sensitive species and cuts cost of labor, materials and chemical analyses for measured concentration tests. (Baker-IVI)
W86-00654

ALLIUM TEST ON RIVER WATER FROM BRAAN AND SAXAN BEFORE AND AFTER CLOSURE OF A CHEMICAL FACTORY,

Lund Univ. (Sweden). Inst. of Genetics.
G. Fiskesjo.
Ambio, Vol. 14, No. 2, p 99-103, 1985. 5 Fig, 2 Tab, 23 Ref.

Descriptors: *Allium test, *Water analysis, *Industrial wastes, *Braan, *Saxan, *Sweden, Water pollution effects, Water quality control, Monitoring, Herbicides, Phenoxyacetic acids, Phenols, Organic compounds, Cytogenetics.

The Allium test has been shown to be helpful and efficient in revealing and evaluating the biological risks attributable to the water of the river Braan (Sweden) and the nearby Saxan after the contamination of the Braan with industrial waste products. The recovery of the river water after the removal of the source of contamination could also be observed with the Allium test. The test is simple and inexpensive and can easily be applied on the mere suspicion of contamination. In its simplest form, involving only measurements of the root bundles after 3-4 days of growth, the test is ideal for rapid scanning of water samples in the field. It may be applied extensively as a preliminary to more sophisticated methods. Good correlation has been demonstrated between reduced root growth and presence of microscopic signs of cell poisoning. Detailed cytogenetic analysis can elucidate the specific types of microscopic aberrations induced. In the present case, in which phenoxyacetic acids and phenols were the culprits, the main cytogenetic aberrations included delayed mitoses and sticky chromosomes, which are known to be characteristic features of this type of poisoning. The experienced cytogeneticist may often gather valuable information about the nature of contaminants from a detailed analysis of cellular responses. (Baker-IVI)
W86-00667

AUTOMATIC WATER QUALITY MONITORING IN RIVERS EXPOSED TO INJURIOUS ACTIVITIES,

National Board of Waters, Helsinki (Finland).
T. Kohonen.
Aqua Fennica, Vol. 14, No. 2, p 97-127, 1984. 13 Fig, 12 Tab, 30 Ref.

Descriptors: *Water quality, *Monitoring, *Rivers, *Finland, Water pollution effects, Construction, Pulp and paper industry, Wastewater pollution, Industrial wastes, Water analysis, Automation.

Automatic mobile water quality monitoring stations were used to investigate the effects of the pulp and paper industry, municipal waste water, water regulation and construction work on the quality of river water. The variations found were also examined to determine the need to change the sampling frequency of manual monitoring. The frequent automatic monitoring revealed short-term variations and gave more reliable means and ranges than monitoring based on infrequent manual sampling. Where extensive data was available from manual monitoring for the same year or a period of several years, the statistical parameter calculated from the manually and automatically collected data were almost the same. In river waters with heavy loading the choice of monitoring method is dependent on the intended use of the data. It is possible to obtain adequate data on the average quality of the water by ordinary sampling at random intervals. By means of automatic monitoring it is possible to examine the effects of various load conditions on the quality of the river water at the times which are of greatest significance (Baker-IVI)
W86-00671

STATISTICAL MODEL FOR CONVERSION OF ABSORBANCE MEASUREMENTS WITH SIGNIFICANT IRON INTERFERENCE INTO ORGANIC CARBON IN A POLYHUMIC LAKE

Helsinki Univ. (Finland). Dept. of Limnology.
V. Pennanen, and T. Frisk.
Aqua Fennica, Vol. 14, No. 2, p 171-178, 1984.
Fig, 2 Tab, 22 Ref.

Descriptors: *Statistical models, *Iron, *Polyhumic lakes, *Humic substances, *Color, Absorbance, Manganese, Aluminium, Water quality, Nitrates, Organic carbon.

Statistical models are presented for taking into account the interference of iron in the conversion of absorbance values into organic carbon in studies of the color of humic waters. The models were calculated for two humic fractions (colloidal and dissolved) which were separated by gell fractionation techniques. An assumption was made that the effect of iron on absorbance was strictly proportional to the iron content of the fraction. There are other interfering substances in absorbance measurements of humic substances. Among these are manganese, aluminium, and nitrate which cause interferences in the optical measurements in the ultra-violet and in the visible regions of the spectra. Coefficients computed on the basis of the data supplied here cannot be applied to other data sets as their general validity has not been tested. (Baker-IVI)
W86-00676

STATISTICAL DETERMINATION OF THE OPTIMAL SAMPLE SIZE OF SECONDARY EFFLUENT BOD5 AND SS,

Environmental Protection Service, Edmonton (Alberta).
E. C. Tsai.
Environmental Monitoring and Assessment, Vol. 5, No. 2, p 177-183, June, 1985. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Model studies, *Biochemical oxygen demand, *Suspended sediments, Statistical models, Mathematical studies, Water quality control, Monitoring.

On the basis of the assumption of random and independent observations from a long-normal population, a statistical model for determining the optimal sample size of secondary effluent BOD5 and SS has been presented. This model is also applicable to a non-lognormally distributed effluent variable if its sample size is large. The model can be used by a plant operator or a regulatory agency to formulate an effluent monitoring plan for an individual municipal or industrial wastewater treatment facility, based on actual historical operation data. To achieve an annual sample geometric mean error within 10% at a 95% confidence level, the optimal sample sizes for activated sludge effluent BOD5 have been found to range, depending on the coefficient of variation, from 40-200 in a year; and for effluent SS, from 40-225 in a year. In Canada, most activated sludge treatment plants have a sample size of less than 40 in a year suggesting their annual true geometric means have not been accurately estimated. (Baker-IVI)
W86-00683

MUTAGENICITY ASSESSMENT OF DIFFERENT DRINKING WATER SUPPLIES BEFORE AND AFTER TREATMENTS,

Perugia Univ. (Italy). Cattedra di Igiene.
S. Monarca, R. Pasquini, and G. S. Sforzolini.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 815-823, June, 1985. 2 Tab, 21 Ref.

Descriptors: *Mutagenicity, *Drinking water, *Water analysis, *Water treatment, Water quality, Chlorination, Water distribution, Chlorinated hydrocarbons.

Three qualitatively different raw water supplies together with their correspondent chlorinated drinking waters were investigated for their mutagenic properties using the Salmonella microsome assay. A drinking water supply distributed through two different types of pipelines was chosen to study the effect of the distribution systems on water mutagenicity. A sequential liquid-liquid extraction at three different pHs and an in situ XAD-2 adsorption technique were used to prepare extracts and adsorbates from both untreated and treated water samples to compare mutagen recovery by these widely used methods. The in situ resin adsorption technique was unable to recover mutagens from all the water samples, while the liquid-liquid extraction technique gave extracts with mutagenic properties without metabolic activation for the two surface waters only after treatment. The appearance of direct acting mutagens after treatment of surface waters could be due to chlorination steps which allowed the chlorine to react with organic substances producing these potentially harmful compounds. The formation of chlorinated organics could be minimized, for instance, by avoiding prechlorination, chlorine concentrations higher than are necessary or by using alternative disinfectants. The liquid-liquid extraction technique showed higher recovery efficiency of mutagens from water samples. Extraction at different pHs gave useful indications about the chemical class of mutagens. Liquid-liquid extraction at pH 2 and testing of this extract by the Ames test with TA98 and TA100 strains is recommended for routine screening of mutagens in drinking water since acidic extracts contributed the major percentage to the total mutagenicity. (Baker-IVI)
W86-00690

ORGANOCHLORINE RESIDUES IN ANIMALS FROM THREE LOUISIANA WATERSHEDS IN 1978 AND 1979,

Louisiana State Univ., Baton Rouge. Dept. of Entomology.
For primary bibliographic entry see Field 5B.
W86-00691

EVIDENCE FOR POLYNUCLEAR AROMATIC HYDROCARBONS IN THE DIET OF BOTTOM-FEEDING FISH,

Roswell Park Memorial Inst., Buffalo, NY. Dept. of Experimental Biology.
For primary bibliographic entry see Field 5B.
W86-00694

MERCURY DISTRIBUTION IN A POLLUTED MARINE AREA. CONCENTRATIONS OF METHYL MERCURY IN SEDIMENTS AND SOME MARINE ORGANISMS,

Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
N. Mikac, and M. Picer.
Science of the Total Environment, Vol. 43, No. 1-2, p 27-39, May, 1985. 3 Fig, 4 Tab, 34 Ref.

Descriptors: *Methyl mercury, *Water pollution, *Marine environment, *Sediments, *Marine animals, Kastela Bay, Adriatic Sea, Mercury compounds, Mussels, Fish, Monitoring,.

Methyl mercury concentrations were measured in various parts of Kastela Bay in the Central Adriatic, which is polluted with inorganic mercury. The values obtained, on a wet weight basis, for sediments were from 2 to 20 micro-g methyl mercury/kg; for the mussel Mytilus galloprovincialis from 10 to 110 micro-g/kg; and for various species of fish from 102 to 1448 micro-g/kg. The methyl mercury content increases by three orders of magnitude going from sediment to fish. The distribution of methyl mercury in relation to the depth of the sediment and the different organs of the mussel is presented. On the basis of the results obtained, it may be concluded that non-migratory species of fish are more suitable for methyl mercury monitoring in the marine environment than are sediment and mussels. (Author's abstract)
W86-00707

TESTING FOR THE TOXICITY OF CHEMICALS WITH TETRAHYMENA PYRIFORMIS,

Gifu Coll. of Medical Technology, Seki (Japan). Dept. of Hygiene.
Y. Yoshioka, Y. Ose, and T. Sato.
Science of the Total Environment, Vol. 43, No. 1-2, p 149-157, May, 1985. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Tetrahymena, *Toxicity, *Bioassay, Protozoa, Partition coefficient, Water analysis.

A test was developed using Tetrahymena pyriformis in order to determine the toxicity of various chemicals. Pre-cultured T. pyriformis was exposed for 24 h at 30 C to various concentrations of chemicals, and the number of T. pyriformis surviving were then counted. The concentration of the chemical, at which the proliferation of T. pyriformis was restricted to one-half of the blank test (EC50), was determined. The method, applied to 57 chemicals, demonstrated that it could be used to detect the chemicals at low concentrations rapidly and with ease. The EC50 values showed a good relationship with 48 h LC50 values for Himedaka (Orizias latipes), and could be explained on the basis of the partition coefficient between water and n-octanol. (Author's abstract)
W86-00711

EFFECTS OF STORAGE ON THE COMPOSITION OF MAIN COMPONENTS IN RAINWATER SAMPLES,

Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 2K.
W86-00717

WET AND DRY DEPOSITION MONITORING IN SOUTHEASTERN MICHIGAN,

General Motors Research Labs., Warren, MI. Environmental Science Dept.
J. M. Dasch, and S. H. Cadle.
Atmospheric Environment, Vol. 19, No. 5, p 789-796, 1985. 4 Fig, 6 Tab, 11 Ref.

Descriptors: *Monitoring, *Wet deposition, *Dry deposition, *Michigan, Water pollution sources, Air pollution, Rain, Snow, Storms, Seasonal variation, Acid precipitation.

Wet and dry deposition as collected by a bucket were measured at two sites in southeastern Michigan for two years. The precipitation has an average pH of 4.27 and SO4(2-) to NO3(-) ratio of 2.0. Particulate dry deposition velocities of 0.6 cm/s for SO4(2-) and NO3(-) and > 2 cm/s for Cl(-), Ca(2+), Mg(2+), Na(+) and K(+) were calculated. The ambient particle composition, dry bucket collection and wet deposition were compared at two sites, one urban and the other rural. Higher ambient particle concentrations and dry deposition rates were measured at the urban site than the rural site, indicating the influence of local emissions. However, local emissions had no effect on the wet deposition concentrations. The influence of more distant source regions was examined by separating the precipitation events by wind direction. The events from the south and east had the highest SO4(2-) to NO3(-) ratios, which corresponded to the areas with the highest sulfur emissions. NO3(-) showed no directional dependence. Wet deposition was examined for the effect of storm type and seasonal trends. Contrary to a recent study on Long Island, higher concentrations of H(+), SO4(2-) and NH4(+) were found in winter rain compared to snow. The wet deposition concentrations of H(+), SO4(2-), and NH4(+) were highest in the summer, while only Na(+) and Cl(-) concentrations were highest in the winter, presumably due to winter road salting. The total deposition of acidic ions was highest in the summer and lowest in the winter, due both to low concentrations and lower precipitation volumes in the winter. The dry deposition as collected by a bucket accounted for 1% of total H(+) deposition, 21% of SO4(2-) deposition, 27% of NO3(-) deposition, 50% of Cl(-) deposition and 61% of Ca(2+) deposition. (Author's abstract)
W86-00719

USE OF WATERSHED CHARACTERISTICS TO SELECT CONTROL STREAMS FOR ESTIMATING EFFECTS OF METAL MINING WASTES ON EXTENSIVELY DISTURBED STREAMS,

Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
For primary bibliographic entry see Field 5C.
W86-00725

AQUATIC BIOASSAY OF 11 PESTICIDES USING LARVAE OF THE MOSQUITO, WYEOMYIA SMITHII (DIPTERA: CULICIDAE),

Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.

D. Strickman.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 133-142, July, 1985. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Pitcher plants, *Mosquitos, *Pesticides, *Larvae, *Bioassay, Assay, Toxicity, Water pollution effects, DDT, Heptachlor epoxide, Chloropyrifos, Malathion, Temephos, Carbaryl, Methomyl, Propoxur, Permethrin, Phenothrin, Resmethrin, Animal behavior.

The sensitivity of the pitcher plant mosquito assay to 11 pesticides representing four widely used groups was established; the assay detected the pesticides in water samples at levels within the ranges approximating with lethal concentrations of several fish species. The lowest concentrations of each pesticide affecting survival and development of larvae, respectively, were as follows (ppb): DDT (50, 50), heptachlor epoxide (10, 5), chlorpyrifos (1, 1), malathion (100, 100), temephos (5, 5), carbaryl (1,000, 1,000), methomyl (5,000, 1,000), propoxur (1,000, 500), permethrin (5, 1), phenothrin (20, 10), and resmethrin (100, 50). In many cases the lowest concentration detected was the lowest concentration used in the assay. The bioassay lasted for 7 days, and effects typically appeared between days 2 and 4. Behavioral signs of intoxication by pesticides included uncoordinated movement, jerky movement, difficulty unflexing, inactivity, and tonic contraction of longitudinal muscles resulting in shortening and thickening of larvae. All toxicants tested caused some or all of these signs, but consistent differences in signs were evident among pesticides, suggesting the possibility of using this assay in identification of pesticide contaminants. (Rochester-IVI)
W86-00733

ION CHROMATOGRAPH PROVIDES RAPID ANALYSIS OF AIR AND WATER,

P. Pecevich.
Pollution Engineering, Vol. 17, No. 3, p 53-55, March, 1985. 1 Fig, 1 Tab.

Descriptors: *Ion chromatography, *Water analysis, *Chromatography, Acid rain, Seawater, Iron, Cobalt, Nickel, Copper, Metals.

Ion chromatography easily measures several ions in a single analysis, and can measure trace amounts of one ion in the presence of large concentrations of other ions. This liquid chromatographic technique utilizes ion exchange resins as the means of separation and uses conductivity for detection and analysis of anions and cations. Because of its high degree of accuracy and reliability, ion chromatography has been designated by the Environmental Protection Agency (USA) as the method of choice for the analysis of acid rain. The ability of ion chromatography to resolve low concentrations of one or several inorganic anions in the presence of high concentrations of other inorganic ions makes it an ideal tool for the analysis of pollutants in sea water. Ion chromatography provides a fast, reliable, and accurate technique to monitor potential pollutants, such as iron, copper, nickel, and cobalt in industrial process wastes, prior to discharge into the environment, or to analyze samples from contaminated areas. A complete anion and cation profile can be obtained in less than 20 min with low ppb detection limits. (Rochester-IVI)
W86-00768

SORPTIVE CAPACITY OF AN AQUATIC MACROPHYTE FOR THE PESTICIDE AMINOCARB,

Ottawa Univ. (Ontario). Dept. of Biology.
P. Weinberger, and R. Greenhalgh.
Journal of Environmental Science and Health, Vol. B20, No. 2, p 263-273, April, 1985. 2 Fig, 14 Ref. NSERC grants GO-204 and A1737.

Descriptors: *Sorption, *Macrophytes, *Aminocarb, *Insecticides, *Hornwort, Aquatic plants, Pesticides, Water pollution effects, Fate of pollutants.

Hornwort (Ceratophyllum demersum) was exposed to a constant 1 micro-g/ml aminocarb concentration for an experimental period of 300-450 h. The concentration of aminocarb in the plant tissue and surrounding water was constantly monitored. Hornwort exhibited a large capacity for the sorption of the pesticide - up to 400 micro-g/g fresh weight in the dark and 1000 micro-g/g fresh weight in the light. Smaller, actively growing sprigs sorbed 5 times more pesticide per gm fresh weight than larger, older sprigs, although total uptake per plant was greater in the larger plants. Incipient necrosis became evident in treated plants after 72 h in the dark and after 312 h in the light while untreated controls remained healthy for the entire period. In living plants, light was a significant factor in increasing the sortptive capacity of the plant. Younger sprigs, with a higher ratio of lear sorptive surface to internodal stem per g fresh wt, provided the largest sink for the pesticide. Membrane conformation and integrity appear to be important factors in determining the capacity of this aquatic plant for pesticide sorption. Because of its large sorptive capacity, Hornwort may provide a good non-target species for monitoring residual pesticides in an aquatic environment. (Collier-IVI)
W86-00812

SULFATE DETERMINATION IN INDUSTRIAL WASTEWATER BY LIQUID CHROMATOGRAPHY WITH POSTCOLUMN SOLID-PHASE REACTION DETECTION,

Proefstation voor Aardappelverwerking, Groingen
K. Brunt.
Analytical Chemistry, Vol. 57, No. 7, p 1338-1341, June, 1985. 4 Fig, 5 Tab, 19 Ref.

Descriptors: *Sulfates, *Industrial wastewater, *Liquid chromatography, *Reaction detection, Potato starch industry, Pollutant identification, Chemical analysis, Chromatography.

A sulfate selective postcolumn solid-phase reactor (SPR) detection system is described for sulfate determination at parts per million (ppm) levels in potato starch industry wastewaters. The effect of the chromatographic flow rate on the conversion reaction in the SPR is discussed. The linear dynamic range of the detection system in combination with the used anion-exchange separation is from about 5 to 400 ppm. The repeatability of the system at the 30 ppm sulfate level is better than 3.5%. The SPR system can be used for about 13 h without noticeable depletion effects. Day-to-day repeatability is good. Application of the described detection system for the sulfate determination industrial wastewaters is discussed. Recoveries in spiked wastewater samples were better than 90%. (Author's abstract)
W86-00819

EXTRACTION AND ENRICHMENT OF CHLORINATED PHENOLS FROM SURFACE WATERS FOR THE DETERMINATION BY CAPILLARY-GC/FTIR-SPECTROSCOPY,

Johannes Kepler Univ., Linz (Austria).
H. Malissa Jr., G. Szolgyenyi, and K. Winsauer.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 321, No. 1, p 17-26, May, 1985. 5 Fig, 3 Tab, 48 Ref. Osterreichischr Fonds zur Forderung der wissenschaftlichen Forschung grant 4807.

Descriptors: *Water analysis, *Chlorinated phenols, *Fourier-transform infrared spectroscopy, *Gas chromatography, Chromatography, Spectroscopy, Phenols.

A method is presented for the separation and substance-specific determination of chlorinated phenols at trace level in surface waters using capillary-GC/FTIR-spectroscopy. Since an injected amount of at least 100 ng is required to obtain well-structured IR spectra, the extraction and enrichment procedure must provide a concentration factor of 10,000 and simultaneously high recoveries. The separation of the complete range of chlorinated phenols was performed without derivatization on a SE54 fused silica WCOT column; the degree of decrease in separation efficiency introduced by the FTIRS detection system is discussed. The applicability of an on-column injection technique using a thermodesorption-and cold trap injector with solvent removal was tested, which allows the injection of large volumes of concentrate. Proceeding from 1 l water volume and a 10 ppb concentration level the chlorophenols were correctly identified by their IR spectra; mean recovery was in the 90% range. The possibility of obtaining information on the identity of matrix components based on IR data only is discussed. (Author's abstract)
W86-00824

SEPARATION AND DETERMINATION OF SELENIUM(IV) IN ENVIRONMENTAL WATER SAMPLES BY AN ANION-EXCHANGE RESIN MODIFIED WITH BISMUTHIOL-II AND DIAMINONAPHTHALENE FLUOROPHOTOMETRY,

Nagoya City Environmental Pollution Research Inst. (Japan).
K. Itoh, M. Nakayama, M. Chikuma, and H. Tanaka.
Fresenius's Zeitschrift fur Analytische Chemie, Vol. 321, No. 1, p 56-60, May, 1985. 5 Fig, 4 Tab, 8 Ref.

Descriptors: *Selenium, *Anion-exchange resins, *Bismuthiol-II, Diaminonaphthalene fluorophotometry, *Resins, *Water analysis, Chemical analysis, Metals, Fluorometry, Tellurium coprecipitation.

Selenium(IV) in environmental water samples was determined fluorometrically following its collection by the use of a new functional resin. The resin was easily prepared from an anion-exchange resin by modification with bismuthiol II. The novel method comprises a combination of the preconcentration with bis II resin and the conventional fluorometry with 2,3-diaminonaphthalene-cyclohexane (DAN). A highly selective adsorption of selenium(IV) was achieved by the formation of stable selenotrisulfide from bismuthiol II and selenium(IV) on the resin. The method was successfully employed for the determination of Se in river water and waste water. The adsorption of selenium(IV) on bis II resin is hardly affected by organic compounds; the tellurium coprecipitation method with ascorbic acid is affected by organic compounds. The method is advantageous for the treatment of environmental samples in the field because selenium can be collected on the resin and adsorbed selenium is very stable and can be stored for determination in the laboratory. (Collier-IVI)
W86-00825

EXTENT OF MONOCHLORAMINE INTERFERENCE IN THE DPD COLORIMETRIC METHOD FOR FREE CHLORINE IN WATER,

Paris-5 Univ. (France). Lab. d'Hydrologie.
N. Strupler.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 134-136, April, 1985. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Monochloramine, *Diethyl-p-phenylene-diamine, *Colorimetry, *Chlorine, Chemical analysis, Water analysis, Reagents, Iodometry.

If standard procedures are followed, that is, obtaining free available chlorine (FAC) readings without a standing period, preferably well within 1 min, coupled wth strict adherence with approved reagent specifications, the interference by levels of monochloramine normally encountered becomes insignificant. Diethyl-p-phenylene-diamine (DPD) results in this way compared favorably with determinations by iodometry. At 21 C, positive FAC errors of 2.6% of the monochloramine concentration per minute were observed when standard reagents were used. In a comparison of standard reagents with non-standard reagents which lacked interference suppressing agents, the nonstandard agents gave considerably larger apparent FAC readings (4.0-9.0% of initial monochloramine content). When 1 minute was allowed to elapse after adding reagents before taking readings, the monochloramine interference for standard reagents was 1.3% at 10 C, 2.6% at 19/20 C, and 3.3 at 26 C in terms of initial monochloramine concentration. (Rochester-IVI)
W86-00833

FIELD-USE OF DISSOLVED OXYGEN ELECTRODES,

Southern Illinois Univ. at Carbondale. Dept. of Geography.
C. W. Prowse.
Journal of Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 179-183, April, 1985. 1 Fig, 23 Ref.

Descriptors: *Dissolved oxygen, *Electrodes, *Field tests, Nomograms, Calibrations, Mathematical equations, Measuring instruments, Water analysis.

During a recent three year study of urban storm water quality, which involved sampling waters often heavily polluted or charged with organic suspended solids, a membrane oxygen electrode and meter were employed for field determinations. The probe and meter both performed well but two problems were identified: There is a measure of uncertainty as to which of several calibration methods were most appropriate to field-use; and, calculation procedures need improvement. Calibration procedures need to be standardized and more closely evaluated, to maintain instrument precision and data comparability. More rapid and convenient calculation procedures are required to obviate the need for commonly used nomograms. A mathematical relationship was derived to undertake the conversion to mg/l. For all practical purposes, the equation obviates the need for the nomogram over the full range of dissolved oxygen concentrations likely to be encountered in natural fresh waters. The equation allows the use of pocket calulators for field use or the use of a main-frame computer in which all primary data may be stored and conversion may be programmed. Although modified Winkler methods most accurately determine dissolved oxygen levels in water in the laboratory, electrodes retain the advantages of field portability, rapidity of use and insensitivity to interferences. (Collier-IVI)
W86-00837

CARBON ADSORPTION ISOTHERM TEST FOR VOLATILE ORGANIC CHEMICALS IN WATER,

R. W. Schneiter, J. Dragun, and T. W. Kalinowski.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 403-405, May, 1985. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Organic compounds, *Volatile compounds, *Carbon adsorption isotherm test, Water analysis, Activated carbon, Isotherms.

A protocol is presented for conducting batch isotherm tests with mixtures of volatile organic compounds in water in such a way as to account for chemical losses from volatilization. Several important modifications to the ASTM standard were necessary to control and measure volatilization losses, as follows: (1) the activated carbon mass range is estimated from pure solute isotherm data, to bracket the anticipated range of carbon effectiveness based on known raw water quality, (2) completely filled glass bottles with airtight, teflon-sealed caps are substituted for stoppered flasks, (3) bottles are agitated for 24 hr instead of 2 hr, (4) samples are not filtered; a minimum of 4 hr settling replaces filtration, and (5) sample controls are used to measure volatilization losses. This protocol has been used as a preliminary step in actual groundwater remedial action projects where design of granular activated carbon absorption equipment has been evaluated. Isotherms for individual, key contaminants or for aggregates of multiple contaminants have been prepared to evaluate carbon treatment effectiveness and to compare different carbons for further study or application. (Rochester-IVI)
W86-00845

SHORT-TERM TEST FOR PREDICTING THE POTENTIAL OF XENOBIOTICS TO IMPAIR REPRODUCTIVE SUCCESS IN FISH,

Swedish Environmental Research Inst., Stockholm.
L. Landner, A. H. Neilson, L. Sorensen, A. Tarnholm, and T. Viktor.
Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 282-293, June, 1985. 6 Fig, 2 Tab, 21 Ref.

Descriptors: *Bioassay, *Fish, *Toxicity, *Reproduction, Anadromous fish, Fish migration, Spawning, Immature growth stages, Water pollution effects, Mortality, Hatching, Zebra fish.

Short-term screening tests with the zebra fish (Brachydanio rerio) have been developed for predicting the potential of xenobiotics to impair reproductive success in fish. The aim was to find simple and sensitive test parameters and to simulate exposure situations typical for anadromous fish species (salmonids), which generally cross heavily polluted coastal areas or estuaries before they reach uncontaminated upstream spawning areas. Therefore, particular attention was directed to tests designed to assess adverse effects induced during gametogenesis in adult fish. The test protocol involves exposure of adults prior to, but not during, spawning and the effects are measured in the offspring as alterations in hatching frequency and hatching rate of eggs, and survival and stress tolerance of embryos and larvae. Some representative examples of the application of these tests are given, and it is some that impairment of reproductive success can be induced by exposure of parent fish prior to spawning at concentrations of xenobiotics at least five times lower than those yielding effects during exposure of embryos and larvae. It is suggested that, in hazard assessment programs, tests of the effect of xenobiotics on the offspring of preexposed adults be routinely incorporated. (Author's abstract)
W86-00874

5B. Sources Of Pollution

MODEL OF SULPHATE CONCENTRATION IN A SMALL STREAM IN THE HARP LAKE CATCHMENT, ONTARIO,

Oslo Univ. (Norway). Dept. of Chemistry.
H. M. Seip, R. Seip, P. J. Dillon, and E. de Grosbois.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 5, p 927-937, May, 1985. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Sulfates, *Streams, *Mathematical models, *Acid rain, *Harp Lake Catchment, *Ontario, Soil chemistry, Oxidation, Solubility, Snowmelt, Catchment area, Sulfur.

The causes of the recent acidification of surface waters in several parts of the world are still a matter of considerable controversy. A better understanding of the acidification mechanisms can be obtained by a combination of field studies and mathematical modelling. A complete model would require very extensive information about the catchment (e.g. precipitation, water chemistry, soil chemistry, vegetation). Very few, if any, data sets in existence satisfy these requirements. A model previously used for Norwegian catchments was modified to predict discharge and sulfur concentration in a stream draining a small catchment in Ontario. The annual input of sulfur roughly balances the output, the average sulfur flux being about 1.6 g S/sq m/yr. The average dry deposition was estimated to be about 0.4 g S/sq m/yr. For good agreement between calculated and observed sulfur concentrations, it was necessary to introduce a reduction (or adsorption) process for sulfate in deeper soil layers during summer and fall. During dry periods, however, sulfate is produced by oxidation in the upper soil layer. The sulfate concentrations in streamwater during snowmelt are remarkably constant. According to model results this could be explained by the existence of a reservoir of easily soluble sulfur in the soil considerably larger than the annual sulfur flux. The basic structure of the models applied to the Ontario stream and to two streams in Norway was the same. It seems likely, therefore, that the model may, with moderate modifications, be applicable to many catchments. (Author's abstract)
W86-00629

CHEMICAL STUDY OF THE SHOHOLA CREEK HEADWATERS, PIKE COUNTY, PENNSYLVANIA,

East Stroudsburg Univ., PA. Dept. of Chemistry.
R. Davis, and C. Y. Cheng.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 2, p 202-206, 1984. 6 Fig, 1 Tab, 8 Ref.

Descriptors: *Shohola Creek, *Pike County, *Pennsylvania, *Chemical analysis, Water analysis, Alkalinity, Hardness, Water properties, Highways.

Factors that contribute to the overall inorganic water quality and the possible effects of Interstate 84 which lies near the Shohola Creek were investigated. The Shohola Creek is located in southeastern Pike County in northeastern Pennsylvania. It is a spring fed creek that starts in the woods and flows into the Delaware River at Shohola. The chemical analyses of the waters revealed a pH which decreased from a high of 7.41 to a low of 6.76 over the test period while the alkalinity shows a gradual increase. Hardness, phosphate-phosphorus, and nitrate-nitrogen showed similar increases. Manganese and iron concentrations were very low and the lead concentrations were almost all negligibly low. During the test period the overall inorganic water quality seemed not be affected by the heavy traffic on Interstate 84, which lies nearby. (Baker-IVI)
W86-00636

USING SIMULATION TO ASSESS THE IMPACTS OF CONSERVATION TILLAGE ON MOVEMENT OF SEDIMENT AND PHOSPHORUS INTO LAKE ERIE,

Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4D.
W86-00650

STUDIES OF WATER POLLUTION OF THE RIVER CAUVERY - PHYSICO-CHEMICAL CHARACTERISTICS,

Bangalore Univ. (India). Dept. of Botany.
R. K. Somashekar.
International Journal of Environmental Studies, Vol. 24, No. 2, p 115-123, 1985. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Water analysis, *River Cauvery, *India, *Physicochemical characteristics, Seasonal variations, Anions, Cations, Agricultural chemicals, Fate of pollutants, Water pollution.

An attempt was made to understand the chemical characteristics of surface waters of the river Cauvery and to correlate the chemical concentration and loads in the river as a function of hydrological parameter, viz. water discharge. Water samples from the river Cauvery, Karnataka, India were collected from three stations located over a distance of 20 km: Station 1 was near Krishnarajasagar dam; Station 2 was located at the point of discharge of effluents from paper and fertilizer factories; Station 3 was located near the confluence of the Cauvery and Kapila rivers. Monthly and seasonal variations in major cations and anions were significant. The regression analysis of transported ions, silica and alkalinity varied with the quantity of river flow and yielded a linear relationship. The transported dissolved load of chemical constituents increased with the discharge, but the concentrations of all the constituents, except silica, calcium and iron, were inversely correlated with the stream discharge at all the stations. The rate of increase of the dissolved load with river discharge is slower for the constituents which are inversely related to discharge, with a significant negative correlation index. The sources of dissolved chemical constituents in the river water of all three stations are most likely the weathering of rocks, minerals and soils in the catchment area. The addition of water from the nearby agricultural fields and of domestic wastes are responsible for variations in some of the parameters, especially at station 2. A short-term investigation into the hydrology of the river water can demonstrate the general trends that exist in the area. (Baker-IVI)

W86-00657

ANALYSIS OF PRECIPITATION CHEMISTRY DATA FROM ALASKA,

National Oceanic and Atmospheric Administration, Rockville, MD. Air Resources Lab.
For primary bibliographic entry see Field 2K.
W86-00659

ACIDIFICATION OF SOUTHERN APPALACHIAN LAKES,

Clemson Univ., SC. Dept. of Environmental Systems Engineering.
R. W. Talbot, and A. W. Elzerman.
Environmental Science and Technology, Vol. 19, No. 6, p 552-557, June, 1985. 2 Fig, 2 Tab, 21 Ref. Department of the Interior grant B-151-SC and NSF grant ISP-8011451.

Descriptors: *Acidification, *Lakes, *Appalachians, *Acid rain, Atmospheric deposition, Chemical properties, Alkalinity, Watersheds, Soil chemistry, Weathering, Reservoirs.

Measurements of the dissolved (< 0.4 micro-m) major element water chemistry of 10 lakes and reservoirs situated in the southern Appalachian Mountain and Carolina Peidmont regions are used to examine effects of acidic atmospheric deposition inputs on water chemistry. In the mountain region, lakes with low alkalinity and a small watershed/lake area ratio appear to be most susceptible to, and may be undergoing, pH reduction. In the Piedmont region, watershed soils, especially those exposed by man's activities, appear to be effectively neutralizing acid inputs. Weathering of rocks and soils accelerated beyond that expected from carbonic acid alone is probably occurring in the mountain and Piedmont systems. The analysis suggests that reduction of lake water pH, mobilization of soil chemical constituents, and subsequent changes in the chemical composition of aquatic systems may be a more widespread and potentially serious environmental problem in this area than previous analyses have suggested. (Author's abstract)
W86-00663

FATE AND EFFECTS OF ORGANOTIN COMPOUNDS,

California Univ., Berkeley. Dept. of Zoology.
R. B. Laughlin, and O. Linden.
Ambio, Vol. 14, No. 2, p 88-94, 1985. 8 Fig, 60 Ref.

Descriptors: *Fate of pollutants, *Organotin compounds, *Tin compounds, Organic compounds, Toxicity, Bioaccumulation, Antifouling paints, Water pollution effects.

The increasing use of organotin compounds may produce environmental problems of both magnitude and duration. At present, additional data are needed to predict with confidence the possible environmental effects posed by these compounds. This review showed that while knowledge is advancing rapidly, there remain serious gaps. In particular, the difficulty of chemical analyses of these compounds poses problems answering questions about biological effects. Nevertheless, it is clear that early information about their lack of toxicity, mode of action and rapid rate of degradation in the environment is inaccurate or only partially correct. Given the enormous number of potential chemical structures possible, modern structure-toxicity quantification is being studied. This information, it is hoped, may be used prior to the appearance of problems. Bioaccumulation potential, as indicated by octanol-water partition coefficients, is large and may prove particularly detrimental to nearshore seafood resources. The use of effective copolymer antifouling paints with low triorganotin release rates is to be encouraged to minimize these problems. Efforts to monitor and control effluents should take into account not only primary constituents, but also redistribution products and impurities since they, proportionally, may be present in low but acutely toxic concentrations. It will only be by prudent use that the benefits of organotins will be maximized and risks minimized. (Baker-IVI)
W86-00665

POTENTIALLY TOXIC BLUE-GREEN ALGAE (CYANOBACTERIA) IN FINNISH NATURAL WATERS,

Helsinki Univ. (Finland). Dept. of Limnology.
P.-E. Persson, K. Sivonen, J. Keto, K. Kononen, and M. Niemi.
Aqua Fennica, Vol. 14, No. 2, p 147-154, 1984. 1 Fig, 7 Tab, 33 Ref.

Descriptors: *Cyanophyta, *Toxins, *Finland, *Coastal waters, Lakes, Toxicity, Phytoplankton, Eutrophication, Water pollution sources.

Blue-green algal blooms in natural waters may result in severe ecological and practical problems, as several species of blue-green algae are capable of producing toxins. The occurrence of potentially toxic blue-green algae in Finland was examined. The survey was restricted to species associated with acute cases of poisoning, typical of exotoxins (hepatotoxins, neurotoxins). The number of samples on record was 5288. Thirteen percent of the samples from freshwaters and one third of the samples from coastal waters contained noteworthy concentrations of potentially toxic blue-green algae. A case of dog poisoning is also reported which resembled the outbreaks in Denmark and Sweden in 1975 and 1982, respectively. The existence of a toxic blue-green algal strain in Lake Vesijarvi is also noted. (Baker-IVI)
W86-00674

POLLUTION LOADINGS FROM FINNISH INLAND FISH-FARMS: A CASE STUDY,

Kuopio Univ. (Finland). Dept. of Occupational and Industrial Hygiene.
E. Parjala, A. Tamminen, and O. V. Lindqvist.
Aqua Fennica, Vol. 14, No. 2, p 205-214, 1984. 13 Fig, 2 Tab, 22 Ref.

Descriptors: *Water pollution sources, *Fish farming, *Finland, Nitrogen, Phosphorus, Phosphates, Aquaculture, Pollution load, Suspended solids, Sludge, Fate of pollutants.

Pollution loadings were studied from a fish-farm in Central Finland producing annually about 200 tons of rainbow trout. The farm has 34 separate ponds with total surface area of 55,800 sq m. Average depth of the ponds and raceways is about one meter. The retention time of the water at the farm was 5 to 8.5 hours. The farm used 25-30% of the water flow of the nearby river. The effluents on the farm had total phosphorus concentrations of 34-120 micro-g/l, total nitrogen concentration of 580-1300 micrg-g/l, suspended solids concentration of 1-9 mg/l and BOD7 of 2.3-5.1 mg oxygen/l. Pollution loadings of the farm were 9.0 to 20.5 gP/kg of fish, 6.0-9.7 gP/kg of feed, 48-108 gN/kg of fish, 26-170 gN/kg of feed, 3.1-19.4 gSS/kg of fish, 5.2-19.5 gSS/kg of feed, 0.2-0.7 g BOD/kg of fish and 0.4-1.1 g BOD/kg of feed. More than 50% of the total phosphorus and more than 70% of the nitrogen in the effluents was soluble. Almost all the phosphorus loading caused by the farm consisted of phosphate-P. The main part of the nitrogen loading consisted of ammonia-N and organic nitrogen compounds. Phosphorus and nitrogen leach very quickly and effectively from the sludge which gathers on the bottom of the raceways. The sludge should be removed once or twice a week from the bottom of the raceways to effectively decrease phosphorus and nitrogen loadings. (Baker-IVI)
W86-00680

MERCURY CYCLE IN LAKES; SOME NEW HYPOTHESES,

National Board of Waters, Helsinki (Finland). Water Research Inst.
M. Verta.
Aqua Fennica, Vol. 14, No. 2, p 215-221, 1984. 3 Fig, 3 Tab, 51 Ref.

Descriptors: *Mercury, *Fate of pollutants, *Organomercury compounds, *Fish physiology, *Bioaccumulation, Temperature effects, Water quality, Acidity, Bacteria, Heavy metals, Metals.

Factors influencing the content of methyl mercury in freshwater biota can be listed as: the amount of methyl mercury to which the organism is exposed, and factors which affect the methylation of mercury or the accumulation of methyl mercury in biota such as temperature, water quality, bacterial activity, size, age, sex, and metabolic differences. Thus the mercury content of freshwater biota varies greatly between individuals of a single species from different environments, even if they were subjected to the same level of contamination. In a study of 35 forest lakes the methyl mercury content in pike was correlated better with the water quality parameters describing the allochtonous organic matter content in the lake than with pH and trophic level. In a typical freshwater lake more than 90% of the mercury that can be methylated and can enter the food chain is in the upermost 5 cm of the bottom sediments and only about 1% is in the fish population. Once assimilated into fish, methyl mercury is bound very strongly to the tissues. When a fish is eaten by a predatory fish the assimilation efficiency for naturally accumulated methyl mercury is only 10-20%. Most of the methyl mercury eaten is excreted in feces. Because the fish population contains such a large fraction of the total amount of methyl mercury, intensive fishing can effectively decrease the amount of methyl mercury cycling in lake biota. This could lead to the decrease of methyl mercury concentrations in fish if the fish population reacts to fishing with more rapid growth. Whatever the impact of fishing on the methyl mercury concentration of fish, it is evident that only with quantitative estimations of methyl mercury amounts in biota, especially in fish populations, can an understanding be gained of the mercury cycle in lakes. (Baker-IVI)
W86-00681

QUALITY OF RUNOFF WATER FROM FINNISH FUEL PEAT MINING AREAS,

Helsinki Univ. (Finland). Dept. of Limnology.
T. Sallantaus.
Aqua Fennica, Vol. 14, No. 2, p 223-233, 1984. 7 Fig, 4 Tab, 22 Ref.

Descriptors: *Water pollution sources, *Peat, *Mining, *Drainage, Acidity, Water quality, Suspended sediments, Chemical oxygen demand, Organic carbon, Bogs, Mires.

A fuel peat mining area with well decomposed peat exposed at the surface is susceptible to erosion. This must be taken into account when planning the peat mining area and measures for reducing the loading of watercourses due to peat mining. The great volume of ditch network should be used as short time storage for runoff water after heavy rains to promote settling of suspended solids. This could be achieved by constructions in the main ditches, which automatically dam water when a certain runoff rate is reached. The effect of such constructions depends greatly on the slope of main ditches and lower parts of field ditches above the construction. These construction should be supplemented by sedimentation basins, which must be situated before mixing with waters from outside the peat mining area takes place, either in the main ditches or at the end of each field ditch. The quantitative changes in the discharge of dissolved organic matter due to peat mining seem to be rather small once the depletion of water storage after drainage has taken place. More attention should be paid to qualitative changes. The acidity of runoff waters from oligotropic peatlands seems to be reduced in many cases after drainage and peat mining and it seems that neutralization of drainage waters, as has sometimes been suggested, is not normally needed. (Baker-IVI)
W86-00682

DISTRIBUTION OF HEAVY METALS IN WATER AND SEDIMENTS OF SELECTED SITES OF YAMUNA RIVER (INDIA); ENVIRONMENTAL MONITORING OF THE YAMUNA RIVER - PART I,

Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, M. A. Khan, and A. A. Nomani.
Environmental Monitoring and Assessment, Vol.

5, No. 2, p 205-214, June, 1985. 1 Fig, 3 Tab, 34 Ref.

Descriptors: *Yamuna River, *India, *Metals, *Sediments, *Water pollution, Water analysis, Carbonates, Copper, Cadmium, Chromium, Iron, Manganese, Nickel, Lead, Zinc, Phosphorus, Industrial wastes, Domestic wastes, Pesticides.

The impact of domestic and industrial effluents on the concentrations of Cd, Cu, Co, Cr, Fe, Mn, Ni, Pb and Zn metals in water and sediments of the Yamuna river was studied at various sampling stations. The mechanism of sedimentation of metals through organic matter, calcium carbonate, and pH was also considered. This study covers a distance of about 840 km and five big cities, namely Delhi, Mathura, Agra, Etawah, and Allahabad. Variation in the concentrations of the elements from one sampling station to another may be due to the variation in the quality of industrial and sewage wastes being added to the water at different points. Sediments of the Yamuna river contained 2.1-5.2% calcium carbonate, a high quantity. The precipitation of a number of metals in the presence of such a high carbonate concentration is obvious. The highest concentrations of iron and manganese in the sediments were detected at Agra and Mathura, 8387.0-9636.0 micro-g/g and 521.0-558.0 micro-g/g, respectively. At Agra a number of iron foundries are situated which directly inject their effluents into the river. Chromium and nickel ranged from 8.60-199.35 micro-g/g and 4.72-39.5 micro-g/g, respectively. Maximum chromium was found at Mathura and maximum nickel values at Delhi. The amount of organic matter was highest at Agra followed by Delhi and Mathura, probably due to the high organic pollution by sewage and synthetic organic pollutants disposed off from these cities. Phosphorus was in the range of 290.0-870.0 mg/kg in the river sediments. This high level may be due to the cremation of dead bodies on the banks of the river and throwing of the ashes into it. Another reason may be the excessive use of organophosphorus pesticides which utimately reach the river through runoff. (Baker-IVI)
W86-00685

ZINC DEPOSITION IN ACID LAKES: THE ROLE OF DIFFUSION,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
R. Carignan, and A. Tessier.
Science, Vol. 228, No. 4707, p 1524-1526, June, 1985. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Zinc, *Diffusion, *Acid lakes, *Sediment-water interfaces, *Lake sediments, *Clearwater Lake, *Ontario, *Tantare Lake, *Quebec, Trace metals, Lakes, Acidity, Fate of pollutants.

The relative importance of the diffusion mechanism has been investigated in two lakes by comparing the present-day rates of zinc accumulation to the calculated diffusive fluxes across the sediment water interface. Duplicate sediment cores were obtained at a depth of 20.2 m in Clearwater Lake, Ontario and at 15.5 m in Tantare Lake, Quebec. The sediment Zn(t) profiles show a maximum at 2.5 to 3.5 cm, with a nearly linear decrease to a constant level at 9 to 10 cm. Such profiles are common in acid lakes. In Tantare Lake, a recent increase in sediment deposition is very unlikely as the lake's watershed has not been disturbed by forest fire, road construction, or wood harvesting for at least the last 100 years. In Clearwater Lake, sediment deposition may have recently increased owing to the extensive deforestation of the watershed 40 to 50 years ago from smelter sulfur dioxide emissions. The transport of trace metals from the water column to the sediments has generally been regarded as a sedimentation process controlled by the extent of trace metal association to the suspended solids and by the rate of sedimentation of the suspended solids. Present results suggest that such a model may not be applicable for zinc in acid lakes, and perhaps for other elements that are present in the water column in relatively high concentrations but are efficiently scavenged in the sediments. Because of the nonsteady state nature of anthropogenic zinc influx in lakes, it may be advisable to use nonsteady-state numerical methods in the interpretation of sedimentary zinc profiles and in the modeling of the early diagenesis of this element and other transition metals in acid lakes. (Baker-IVI)
W86-00689

ORGANOCHLORINE RESIDUES IN ANIMALS FROM THREE LOUISIANA WATERSHEDS IN 1978 AND 1979,

Louisiana State Univ., Baton Rouge. Dept. of Entomology.
P. F. Dowd, G. U. Mayfield, D. P. Coulon, J. B. Graves, and J. D. Newsom.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 832-841, June, 1985. 6 Tab, 7 Ref. U.S. Department of the Interior, Patuxent Wildlife Research Center contract 14-16-0009-77-950.

Descriptors: *Chlorinated hydrocarbons, *Louisiana, *Lake Verret, *East Franklin, *Bayou Plaquemine-Brule, *Pesticides, *Water pollution effects, *Animal tissues, Fate of pollutants, Fish, Crustaceans, Mammals, Birds, Insecticides, Heron, Raccoons, Shad, Catfish, Crappie, Frogs, Crawfish, Benzene hexachloride, Chlordane, Compound E, DDD, DDT, DDE, Dieldrin, Endrin, Heptachlor, Polychlorinated biphenyls, Nonachlor, Toxaphene.

Organochlorine pesticide residues were detected in some, but not all, samples of animal tissue obtained three sites in Louisiana. The sites reflected different levels of pesticide use: East Franklin, formerly heavy organochlorine insecticide use; Bayou Plaquemine-Brule, intermediate insecticide use; and Lake Verret, low insecticide use. Samples of yellow-crowned night heron (Nyctanassa violacea) water snakes (Natrix spp.), raccoons (Procyon lotor), shad (Dorosoma spp.), channel catfish (Ictalurus punctatus), crappie (Pomoxis spp.), frogs (Rana spp.) and crawfish (Procambarus clarkii) were obtained in 1978 and 1979. Chromatographic methods were used for detection of alpha- and beta-benzene hexachloride, alpha- and gamma-chlordane, compound E, DDD, DDE, DDT, dieldrin, endrin, heptachlor, polychlorinated biphenyls (PCBs) trans- and cis-nonachlor, and toxaphene. The compounds most frequently found as residues in catfish whole body, crappie, shad, and heron were DDE, dieldrin, and PCBs in samples from the Lake Verret site. DDE and dieldrin generally declined from 1978 to 1979, but levels of PCBs stayed approximately the same or increased during this period. The compounds most frequently encountered as residues in samples from catfish whole body, heron, shad, crappie, crawfish, and snakes at the Plaquemine-Brule site were chlordane isomers, DDE, and PCBs. While DDE and chlordane tended to decline from 1978-1979, PCBs remained the same or increased. At the East Franklin site, residues from catfish whole body, crappie, heron, and shad primarily consisted of DDE and PCBs, except for shad, which had residues of several compounds in 1978. DDE levels declined in all types of samples except shad from 1978 to 1979; PCBs remained fairly constant. Heron and shad are apparently the species most likely to accumulate organochlorine residues, regardless of contamination level at the site of collection, which allows them to serve as indicator species for organochlorine contamination in Louisiana. (Rochester-IVI)
W86-00691

METABOLISM OF ALDRIN BY THE FRESHWATER PLANARIAN PHAGOCATA GRACILIS,

Middle Tennessee State Univ., Murfreesboro. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-00693

EVIDENCE FOR POLYNUCLEAR AROMATIC HYDROCARBONS IN THE DIET OF BOTTOM-FEEDING FISH,

Roswell Park Memorial Inst., Buffalo, NY. Dept. of Experimental Biology.
A. E. Maccubbin, P. Black, L. Trzeciak, and J. J. Black.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 876-882, June, 1985. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Fish, *Polynuclear aromatic hydrocarbons, *Fish food, *Stomachs, *Lake Erie, Hydrocarbons, Suckers, Fluoranthene, Sediments, Flourene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzanthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, benzo(g,h,i)perylene, indeno(1,2,3-c,d)pyrene.

High Pressure liquid chromatography studies of stomach contents of white suckers (Catastomus commersoni) collected at three sites in eastern Lake Erie (USA) demonstrated the presence of substantial concentration of polyaromatic hydrocarbons (PAH). Samples collected at Crescent Beach ('clean') and 18 Mile Creek ('relatively clean') had similar chromatographic profiles, although concentrations of certain PAHs differed. The profile from Smokes Creek ('polluted') had more PAH, and generally at higher concentrations, with the exception of 731.84 nanogram/g wet wt fluoranthene at Crescent Beach. Sediment from Smokes Creek had a chromatographic PAH profile similar to that observed for fish stomach contents from that site, with each individual peak resolved, in the sediment but at higher concentrations. Compounds identified in this study were fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzanthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, benzo(g,h,i)perylene, and indeno(1,2,3-c,d)pyrene. Analysis of stomach contents of bottom-feeding fish might be used to determine PAH levels in areas where sediment samples are difficult to obtain. (Rochester-IVI)
W86-00694

PCBS IN STRIPED BASS COLLECTED FROM THE HUDSON RIVER, NEW YORK, DURING FALL, 1981,

State Univ. of New York at Albany. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 5C.
W86-00695

TOXICITY AND ACCUMULATION OF COPPER AND CADMIUM IN THE ALGA SCENEDESMUS OBLIQUUS LH,

Vysoka Skola Zemedelska v Praze, Ceske Budejovice (Czechoslovakia). Faculty of Agricultural Economics and Management.
For primary bibliographic entry see Field 5C.
W86-00697

SIMULATED SOLUTE MOVEMENT IN WASTEWATER-PONDED SOIL,

Florida Univ., Gainesville. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5D.
W86-00699

SOLUTE DISPERSION DURING AXISYMMETRIC THREE-DIMENSIONAL UNSATURATED WATER FLOW,

Department of Scientific and Industrial Research, Palmerston North (New Zealand). Div. of Plant Physiology.
For primary bibliographic entry see Field 2G.
W86-00700

SOLUTE DISCHARGE DURING STEADY WATER DRAINAGE FROM A SAND TANK,

Florida Univ., Gainesville. Dept. of Plant Pathology.
For primary bibliographic entry see Field 2G.
W86-00701

MONTE-CARLO SIMULATION OF NONINTERACTING SOLUTE TRANSPORT IN A SPATIALLY HETEROGENEOUS SOIL,

Texas A and M Univ., College Station.
For primary bibliographic entry see Field 2G.
W86-00702

MOBILITY OF ZINC, CADMIUM, COPPER, LEAD, IRON AND ARSENIC IN GROUND WATER AS A FUNCTION OF REDOX POTENTIAL AND PH,

Essen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 9 - Geologie.
R. Hermann, and P. Neumann-Mahlkau.
Science of the Total Environment, Vol. 43, No. 1-2, p 1-12, May, 1985. 11 Fig, 23 Ref.

Descriptors: *Groundwater pollution, *Zinc, *Cadmium, *Copper, *Lead, *Iron, *Arsenic, *Redox potential, *Hydrogen ion concentration, Path of pollutants, Solubility, Soil contamination, Heisinger Aue, Germany (Federal Republic).

In most industrialized regions, surface water and soil are contaminated with Cd, As, Pb, and Zn as a result of air and water pollution over many years. When the groundwater table moves up into the zone of contaminated soil, the redox potential and ph, as well as the mobility of the toxic elements are changed and can pose a threat if the contaminated area is a source of drinking water. The analysis of ground water taken from different soil horizons in the Heisinger Aue area (Essen, Federal Republic of Germany) confirmed the theoretically calculated influence of the redox potential and pH on the mobility of these elements. Zn, Cd, and Cu only show a pronounced solubility in an oxidizing environment. The degree of solubility in such environments depends largely on the pH. In a reducing environment, the solubility of Zn, Cd, and Cu can be decreased because of sulfide formation. Within the ranges of Eh and pH observed the mobility of Pb seems to be relatively low. Arsenic, like Fe, was found to be much more mobile under reducing than under oxidizing conditions. Groundwater of low Eh may be contaminated by As contained in polluted soils, sediments, or wastes. (Moore-IVI)
W86-00706

MERCURY DISTRIBUTION IN A POLLUTED MARINE AREA. CONCENTRATIONS OF METHYL MERCURY IN SEDIMENTS AND SOME MARINE ORGANISMS,

Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5A.
W86-00707

CHEMICAL COMPOSITION OF HIGHWAY DRAINAGE WATERS; I. MAJOR IONS AND SELECTED TRACE METALS,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
R. M. Harrison, and S. J. Wilson.
Science of the Total Environment, Vol. 43, No. 1-2, p 63-77, May, 1985. 2 Fig, 3 Tab, 27 Ref.

Descriptors: *Drainage water, *Chemical composition, *Trace metals, *Highways, Dissolved solids, Particulate matter, Potassium, Magnesium, Sodium, Calcium, Chloride, Sulfates, Lead, Iron, Manganese, Copper, Cadmium, Storm runoff.

Measurements of volumetric discharge and concentrations of dissolved (< 0.45 micro-m) and particulate (> 0.45 micro-m) major ion and trace metal components or road drainage water have been made during ten storm events at a motorway site in northwest England. With the exception of K(+) and Mg(2+), which were often significantly associated with the particulate (> 0.45 micro-m) fraction, the major ion constituents (Na(+), Ca(2+), Cl(-) and SO4(2-) were predominantly in the dissolved (< 0.45 micro-m) fraction. Of the trace metals, Pb and Fe were largely particle-associated, Mn was predominantly dissolved, and Cu and Cd exhibited intermediate behavior. A 'first flush' effect is seen for the dissolved (< 0.45 micro-m) components, but the particle-associated elements show a much more complex temporal variation related to storm intensity and the flushing of large-grained sediment through the drainage system. (Author's abstract)
W86-00708

CHEMICAL COMPOSITION OF HIGHWAY DRAINAGE WATERS; II. CHEMICAL ASSOCIATIONS OF METALS IN THE SUSPENDED SEDIMENT,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
R. M. Harrison, and S. J. Wilson.
Science of the Total Environment, Vol. 43, No. 1-2, p 79-87, May, 1985. 3 Fig, 3 Tab, 9 Ref.

Descriptors: *Highways, *Drainage waters, *Metals, *Suspended sediments, Lead, copper, Iron, Manganese, Runoff, Particle size.

Chemical associations of metals in the suspended sediment fraction of highway drainage waters have been investigated. Significant positive correlations between concentrations of pairs of metals in the suspended particles (> 0.45 micro-m) were found, the most highly correlated being Pb and Cu, Fe and Cu, and Fe and Mn. The concentrations of metals in the suspended sediment decrease with increasing concentrations of suspended solids in the runoff water indicative of lower metal concentrations associated with larger grained sediments suspended at high discharge rates. Sequential extraction of suspended solids separated by centrifugation showed similar chemical associations of metals to those in road surface dusts, with a generally higher overall metal concentration in the suspended solids. This is interpreted as indicating that the suspended sediment is derived from road surface dusts modified by preferential suspension of the finer grain sizes. (Author's abstract)
W86-00709

CHEMICAL COMPOSITION OF HIGHWAY DRAINAGE WATERS; III. RUNOFF WATER METAL SPECIATION CHARACTERISTICS,

Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
R. M. Harrison, and S. J. Wilson.
Science of the Total Environment, Vol. 43, No. 1-2, p 89-102, May, 1985. 1 Fig, 7 Tab, 12 Ref.

Descriptors: *Highways, *Drainage waters, *Runoff, *Metals, *Chemical speciation, Cadmium, Copper, Lead, Manganese, Iron, Storm runoff, Hydrogen ion concentration, Flow.

As part of an investigation of the removal of road surface contaminants in runoff water, samples of road drainage water have been examined by a comprehensive speciation scheme involving size discrimination by filtration through Nuclepore filters, anodic stripping voltammetry both with and without UV irradiation, and equilibration with Chelax resin, with a view to understanding the chemical associations of Cd, Cu, Pb, Mn and Fe in the waters. Samples were taken to represent different stages of a storm event and changes in speciation are seen to reflect changes in the flow regime and pH of the drainage water system. Upon leaving the highway, the waters enter a small receiving stream in which the speciation characteristics of the water downstream of the outfall were found to be dominated by the input drainage waters. (Author's abstract)
W86-00710

EULERIAN MODEL FOR SCAVENGING OF POLLUTANTS BY RAINDROPS,

General Motors Research Labs., Warren, MI. Environmental Science Dept.
S. Kumar.
Atmospheric Environment, Vol 19, No 5, p 769-778, 1985. 6 Fig, 4 Tab, 24 Ref.

Descriptors: *Rain, *Scavenging, *Air pollution, *Eulerian models, Water pollution sources, Simulation, Adsorption, Differential equations, Hydrogen ion concentration, Ammonia, Hydrogen peroxide, Sulfur dioxide, Formaldehyde, Nitric acid, Solubility.

An Eulerian model for simulating the coupled processes of gas-phase depletion and aqueous-phase accumulation of the pollutant species during a rain event has been formulated. The model is capable of taking into account any realistic vertical profile of pollutant species concentrations and time-dependent initial aqueous-phase concentrations at the cloud base. The model considers the processes of single species absorption and dissociation in the aqueous phase. The coupled partial differential equations constituting the model are discretized into a set of ordinary differential equations by using the Galerkin method with chapeau functions as the basis functions. These equations are solved to obtain the pollutant concentrations of the gas phase and raindrops as well as the pH of raindrops as a function of time and distance below cloud-base. Simulations are performed for scavenging of gaseous HNO3, H2O2, SO2, formaldehyde and NH3. For the case of highly soluble HNO3 and H2O2, raindrops are far from equilibrium with gas phase and their capacity for absorption of these gases is undiminished even as they reach ground level. The gas-phase concentrations for these species decrease exponentially with time and the washout is determined primarily by the rain intensity and mass-transfer coefficient of the gaseous species to the raindrops. The pollutant species concentrations in raindrops are an almost linear function of the distance below the cloud base. For the simulation conditions considered in this study, the half-life periods of these gases for removal from the atmosphere range from 15 to 40 min. For SO2 and formaldehyde, the aqueous-phase concentrations approach equilibrium as the drops fall to ground level and the gas-phase concentrations show large gradients in the vertical. Half-life periods for SO2 range from 1.3 to 13 h depending on the initial raindrop pH and rain intensity. For formaldehyde, the half-life ranges from 19 to 63 min. Solubility of NH3 is a strong function of the raindrop pH. As NH3 is absorbed, the raindrop pH increases and NH3 solubility decreases. For pre-acidified drops (pH = 4.6), ammonia solubility is very high and the drops are far from equilibrium with the gas phase throughout the falling period. The half-life for ammonia ranges from 11 min to over 3 h in these simulations. (Author's abstracts)
W86-00718

WET AND DRY DEPOSITION MONITORING IN SOUTHEASTERN MICHIGAN,

General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5A.
W86-00719

NUTRIENT FLUXES IN EUTROPHIC COASTAL LOUISIANA FRESHWATER LAKE,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W86-00724

HEAVY METAL CONCENTRATIONS IN MUNICIPAL WASTEWATER TREATMENT PLANT SLUDGE,

O'Brien and Gere Engineers, Inc., Syracuse, NY.
S. J. Spiegel, J. K. Farmer, and S. R. Garver.
Bulletin of Environmental and Toxicology, Vol, 35, No. 1, p 38-43, July, 1985. 3 Tab, 12 Ref.

Descriptors: *Municipal wastewater, *Wastewater treatment, *Sludge, *Heavy metals, *New York, Fate of pollutants, Metals, Primary wastewater treatment, Secondary wastewater treatment, Industrial wastes, Industrial wastewater, Water pollution sources.

Analysis of metals in final sludges from 11 municipal wastewater treatment plants in New York State revealed wide variations among plants for a given metal. Final sludges from Schenectedy, Geneva, Dunkirk, Poughkeepsie, Herkimer County, Jamestown, Peekskill, and Yonkers had received secondary treatment; sludge samples from Mamaroneck, Port Chester, and Blind Brook had received only primary treatment. Concentrations of priority pollutant metals at the plants in which secondary treatment was employed varied widely (all in mg/kg), for example: Ag, 0.62-54; As, 0.03-4.6; Cd, 0.15-14.6; Cr (total), 1.6-3,628; Hg, 0.07-9.81; and Pb, 6.1-472. Wide variations were also seen in values for sludges receiving only primary treatment. Within the two groups, Yonkers and Port Chester, respectively, had generally much lower levels of most heavy metals than the other plants,

but the variability in analyses among the remaining plants was so great no categorization based on heavy metals was possible. The differences among sludges in terms of heavy metal content seem to be due to differences in local industrial contributions to the wastewater and differences in domestic contributions of specific heavy metals. (Rochester-IVI)
W86-00726

FACTORS INFLUENCING THE HIGH CONTENT OF BROMINATED TRIHALOMETHANES IN BARCELONA'S WATER SUPPLY (SPAIN),

Sociedad General de Aguas de Barcelona (Spain).
F. Ventura, and J. Rivera.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 73-81, July, 1985. 3 Fig, 5 Tab, 12 Ref.

Descriptors: *Brominated trihalomethanes, *Barcelona, *Spain, *Water supply, *Llobregat River, Water quality, Chlorine, Water treatment, Fate of pollutants, Water pollution sources.

Bromide from salt mines upstream, chlorine added during treatment, and total organic carbon all appear to play roles in trihalomethane (THM) formation in the water supply of Barcelona, Spain. Water samples from the Llobregat River, a stream heavily polluted from textile, galvanic, coal, salt works, and pulp mill industries, and farms and residences, were subjected to a series of tests to determine the source of the THMs. Maximum THM formation occurred about 20 hr after addition of Cl2 to the raw water, which is in agreement with results with finished water. As Cl2 concentration was increased from 5-50 mg/l, there was a shift towards more chlorinated compounds at the expense of more brominated ones. A change of as little as 1 mg/l Cl2 in these waters of high ammonia and bromide content increased the THM content by more than 30% in some cases. It was also established that formation of chloroamines proceeds more rapidly than synthesis of hypobromite, and therefore bromoamines are probably produced at higher rates than BrTHMs which accounts for the low levels of BrTHMs measured. After 6 wk, the efficiency of granular activated carbon for removal of THMs dropped to below 20%, with some compounds, such as CHCl3, being retained at less than 20% efficiency within 3-4 wk. This appeared to be due to the organic pollution load of this water. THM levels in Barcelona's drinking water exhibit strong variations associated with the irregular releases at the salt mines, other industrial activity along the river, and the extreme changes in river discharge. Inconsistent results were obtained in an attempt to correlate THM content with total organic carbon. High levels of BrTHMs should be reduced by installation of a pipeline leading salt mine wastes directly to the sea. (Rochester-IVI)
W86-00727

STORM WATER RUNOFF FROM INDUSTRIAL SITES,

Baxter and Woodman, Inc., Crystal Lake, IL.
D. R. Gavle.
Pollution Engineering, Vol. 16, No. 12, p 34-37, December, 1984. 3 Fig.

Descriptors: *Storm runoff, *Runoff, *Water pollution sources, *Industrial plants, Industrial wastes, Rainfall-runoff relationships, Urban runoff.

If contaminated runoff is leaving an industrial site, an investigation should be instituted that consists of the following steps: (1) analysis of storm water runoff samples to determine the types and quantities of pollutants present, (2) determination of the peak runoff rates and runoff volumes for the site, (3) determination of required reduction in pollutants (depending on whether site is a point or nonpoint source), (4) evaluation of different management techniques, and (5) development of an effective mangement strategy. A typical equation for determining peak runoff rates is: Q = C x I x A, where Q = peak runoff rate in cu ft/sec of water, C = a dimensionless runoff coefficient based on the surface characteristics of the site, I = rainfall intensity in inches/hr, and A = the size of the drainage area in acres. Values of runoff rates increase according to rainstorm frequency (100 yr > annual), and according to type of development (downtown business > industrial > residential). For example, the runoff expected from a residential area with a rainstorm that would be expected to occur every 2 yr (0.51 cu ft/sec/acre) is much less than the 2 yr-occurrence figure for a downtown business area (1.23 cu ft/sec/acre). Management techniques available for control of runoff from industrial sites include segregation of polluted runoff from nonpolluted runoff, spill containment, and, if necessary, treatment to remove pollutants before discharge. (Rochester-IVI)
W86-00766

TRACE-METAL CONCENTRATIONS IN SEDIMENTS FROM TWO CLOSED-BASIN LAKES. ANTARCTICA,

New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 2H.
W86-00770

MATHEMATICAL MODEL FOR ANALYSIS OF SEDIMENT CORE DATA: IMPLICATIONS FOR ENRICHMENT FACTOR CALCULATIONS AND TRACE-METAL TRANSPORT MECHANISMS,

Freshwater Biological Association, Ambleside (England).
J. Hilton, W. Davison, and U. Ochsenbein.
Chemical Geology, Vol. 48, No. 1/4, p 281-291, March, 1985. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Mathematical models, *Trace metals, *Enrichment factors, *Sediments, Fate of pollutants, Aluminum, Potassium, Magnesium, Zinc, Cadmium, Iron, Nickel, Copper, Lead, Clay, Minerals, Lake sediments.

The concentration of trace metal within a sediment core has been modelled by considering three components, the background concentration, C sub b, that due to accelerated erosion, C sub a, and an anthropogenic pollution term, C sub p. Major cations associated with clay minerals such as Al, K and Mg do not have a pollution component. Iterative regression of the trace-metal concentration against one of these elements permits the isolation of C sub p. The model was applied to a comprehensive data set for a sediment core collected from a seasonally anoxic lake. Three groups of trace metals were identified. Type A (Zn and Cd) did not have a component due to accelerated erosion, C sub a. They are thought to have passed through a solution phase before being recruited to the sediment. Type-B metals (Fe, Ni, Cu and Pb) correlated well with the clay mineral elements and were probably transported to the sediment as particles. Mn, the type-C metal, was inversely related to the clay mineral cations, reflecting its labile redox chemistry. Various methods of calculating metal enrichment were compared with the new enrichment after regression analysis procedure (ERA method). Although simple concentration ratios are appropriate for type-A metals neither this procedure nor enrichment factors can adequately assess enrichment of type-B metals. (Author's abstract)
W86-00772

INFLUENCE OF PH ON THE BINDING CAPACITY AND CONDITIONAL STABILITY CONSTANTS OF ALUMINUM AND NATURALLY-OCCURRING ORGANIC MATTER,

Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 2K.
W86-00773

STATUS OF NONPOINT SOURCE POLLUTION: ITS NATURE, EXTENT AND CONTROL,

Battelle Columbus Div., OH.
B. W. Vigon.
Water Resources Bulletin, Vol. 21, No. 2, p 179-184, April, 1985. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, Water pollution sources, Water quality, Stream pollution.

Nonpoint source pollution remains as the primary reason for the designation of many of the Nation's streams as 'water quality limited.' This means that even with the application of technology-based effluent limitations on point sources, ambient water quality standards will not be met. This paper explores several of the reasons why nonpoint sources are so difficult to come to grips with. These reasons include: (1) the inability to expand the definition of nonpoint sources to encompass nonengineering attributes, (2) the relatively primitive state of characterizing nonpoint sources, (3) the lack of prior success in conducting programs to study and alleviate nonpoint problems, and (4) and uncertain approach to providing incentives for control practices. (Author's abstract)
W86-00779

POLLUTANT RUNOFF MODELS: SELECTION AND USE IN DECISION MAKING,

Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
K. H. Reckhow, J. B. Butcher, and C. M. Marin.
Water Resources Bulletin, Vol. 21, No. 2, p 185-195, April, 1985. 1 Fig, 47 Ref.

Descriptors: *Runoff, *Model studies, *Path of pollutants, *Decision making, Water quality managment, Planning, Costs, Simulation, Phosphorus. Eutrophication.

Models for pollutant runoff can be useful in water quality management planning if appropriately structured for the problem at hand. Accordingly, a 'top-down' approach is proposed for the examination of extant pollutant runoff models. The approach consists of the identification of objectives and attributes that reflect the needs of planners and decision makers when these models are used for water quality management planning. Ideally, the attributes should concern the effect of model information on improved decision making and the cost of model application. Practical difficulties with the first attribute necessitates substitution of surrogate attributes reflecting model appropriateness, resolution, and uncertainty. Common pollutant runoff models, in particular export coefficients and hydrology-driven simulation models, are found to have serious weaknesses on some of the attributes scales. The 'top-down' approach leads to a set of desirable pollutant runoff model attributes; alternate modeling techniques are thus examined in order to identify promising future directions for model development. The focus of this examination is phosphorus, due to its importance in the eutrophication of surface waters. Models for both sediment-attached and dissolved phosphorus are considered. Among the conclusions is the belief that the partial contributing area concept can yield an effective yet simple simulation despite the variable and complex nature of runoff. (Author's abstract)
W86-00780

URBAN RUNOFF: POLLUTION SOURCES, CONTROL, AND TREATMENT,

Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
For primary bibliographic entry see Field 5G.
W86-00781

CHEMICAL COMPONENTS IN THE PRECIPITATION AT KOMORO AND TSUKUBA, JAPAN IN 1983,

Meteorological Research Inst., Tokyo (Japan).
Y. Dokiya, Y. Katsuragi, and S. Kobayashi.
Journal of Environmental Science and Health, Vol. A20, No. 3, p 269-291, April, 1985. 7 Fig, 5 Tab, 8 Ref.

Descriptors: *Chemistry of precipitation, *Precipitation, *Honshu Island, *Acid rain, *Japan, Hydrogen ion concentration, Chlorides, Nitrates, Sulfates. Sodium, Potassium, Calcium, Magnesium, Water pollution sources, Air pollution, Spatial distribution.

The net deposition of major chemical components by precipitation in the Honshu Island of Japan was

investigated during each precipitation event for one year in 1983 at two sites: Komoro City, an inland city and Tsukuba Science City, which was located on the Pacific side. Both sampling sites are at a similar latitude and are rural areas of similar population. The concentrations of hydrogen ion, chloride, nitrate, sulfate, sodium, potassium, calcium and magnesium ions were determined in samples from each rain and summarized on a monthly basis. The concentrations of hydrogen, sulfate and nitrate ions were several times higher at Tsukuba than at Komoro. The average pH at Tsukuba and Komoro were 4.54 and 5.34, respectively; the former was apparently influenced by the polluted air from the industrial area including Tokyo and the latter was comparatively free from the influence. The identification of sources for each chemical component is discussed. (Author's abstract)
W86-00810

DISTRIBUTION AND PERSISTENCE OF AMINOCARB IN STREAM WATER, SEDIMENT AND FISH AFTER APPLICATION OF THREE MATACIL FORMULATIONS,

Forest Pest Management Inst., Sault Sainte Marie (Ontario).
K. M. S. Sundaram, and S. Szeto.
Journal of Environmental Science and Health, Vol. B20, No. 2, p 187-200, April, 1985. 2 Fig, 3 Tab, 5 Ref.

Descriptors: *Aminocarb, *Insecticides, *Fate of pollutants, *Path of pollutants, *Streams, *Fish, *Sediment, Water pollution effects, Trout, Pesticides.

Three aminocarb formulations, water-based Matacil 180F, oil-based Matacil 180F and oil-based Matacil 180D, were applied separately to the surface of a stream at 2.40 g a.i./min for 5 minutes. The highest aminocarb concentration in the top 1 cm of water (5000 ppb) was found 5 min after application of oil-based 180F. The next highest concentration was 1862 ppb found in the top 1 cm layer of water 3 min after application of oil-based 180D, followed by 1306 ppb found 5 min after application of water-based 180F. Residue accumulations were first observed in sediment at 3 min and in fish tissues 0.5 h after application. The levels of accumulation were in the order of water-based 180F > oil-based 180F > oil-based 180-D. After the application of water-based 180F, the highest concentrations were 20.2 ppb in sediment after 5 min and 127 ppb in fish tissues after 3 h. Residues disappeared rapidly from all three matrices and could not be detected after a period of 3-25 h. (Author's abstract)
W86-00811

SORPTIVE CAPACITY OF AN AQUATIC MACROPHYTE FOR THE PESTICIDE AMINOCARB,

Ottawa Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W86-00812

DISTRIBUTION OF GAMMA EXPOSURE RATES IN A REACTOR EFFLUENT STREAM FLOOD PLAIN SYSTEM,

Savannah River Ecology Lab., Aiken, SC.
J. B. Gladden, K. L. Brown, M. H. Smith, and A. Towns.
Health Physics, Vol. 48, No. 1, p 49-59, January, 1985. 3 Fig, 3 Tab, 26 Ref. U.S. DOE contract DE-AC09-76SR00819.

Descriptors: *Gamma radiation, *Cesium radioisotopes, *Fate of pollutants, Path of pollutants, Radiation, Radioisotopes, Sediments.

Ground-level gamma dosimetry surveys were conducted along the length of a radiocesium-contaminated reactor effluent stream flood plain system to determine the extent and patterns of isotope distribution over a decade after reactor releases were stopped. The maximum mean exposure rates were found at upstream locations near the source of the contamination and in a downstream sedimentary delta. Gamma exposure rates were not uniformly distributed and high exposure rates were generally restricted to small areas of the flood plain. There was little similarity in either the spatial distribution or magnitudes of maximum gamma exposure rates across flood plains along the stream. Frequency distributions of the measured exposure rates tended to be highly skewed and most closely approximated the log-normal distribution in most areas along the stream. However, the complex and changing patterns of dose distributions strongly affected the ability to predict the probability of encountering unusually high exposure rates. Complex statistical and distributional models are required to provide precise descriptions of the dosimetry environment in such complex ecosystems and different models could be required on a site-by-site basis. (Author's abstract)
W86-00821

RADIOCESIUM LEVELS IN IRISH SEA FISH AND THE RESULTING DOSE TO THE POPULATION OF THE IRISH REPUBLIC,

Trinity Coll., Dublin (Ireland). Dept. of Pure and Applied Physics.
I. R. McAulay, and C. Doyle.
Health Physics, Vol. 48, No. 3, p 333-337, March, 1985. 2 Fig, 1 Tab, 4 Ref. Commission of European Communities contract B10/B/383/80/EIR(H).

Descriptors: *Cesium radioisotopes, *Irish Sea, *Fish, *Public health, *Radiation, *Sellafield, Path of pollutants, Whiting, Cod, Plaice, Prawn, Herring.

Radioactive wastes in have been released from the nuclear fuel reprocessing plant at Sellafield (formerly 'Windscale') for longer than two decades under license from British authorities. Most monitoring has been conducted in the Eastern Irish Sea close to the discharge point with the result that less is known about radiocesium levels off the Irish coast. Whiting, cod, plaice, prawn, and herring samples were obtained from the commercial fishing grounds off the East Irish Coast and assayed for Cs-137 and Cs-134 contamination; average activities of 68 and 3 Bq/kg (wet, fillets) of Cs-137 and Cs-134, respectively, were determined. The ratio of Cs-137 to Cs-134 present in the samples was about 23; during the same period, the ratio in fish caught near Sellafield was about 15. The difference in the ratios is explained by the time taken for transport of the radiocesium from the East Irish Sea to the West Irish Sea and the average residence time in the West Irish Sea; this time lag can be estimated from these ratios to be about 1.4 yr. The radiation dose incurred by a person eating fish will depend on the average activity of the fish and the quantity eaten. The average activity of different species will in general be different. The assumed dose rate due to penetrating environmental radiation for the collective population is 3400 man-Sv/y. The estimated population dose to the Irish public due to fish consumption is approximately 2 man-Sv/y - only 0.06% of the environmental dose. Critical groups may exist, such as fishing communities along the east coast, for whom doses may be higher. The possible dose to a member of the critical group is 1.4% of the limit recommended by the International Commission on Radiological Protection. (Collier-IVI)
W86-00822

RADIOLOGICAL IMPACT OF MINING IN A TH-RICH NORWEGIAN AREA,

Statens Inst. for Straalehygiene, Oslo (Norway).
E. Stranden.
Health Physics, Vol. 48, No. 4, p 415-420, April, 1985. 6 Tab, 12 Ref.

Descriptors: *Radioisotopes, *Mining, *Thorium, *Norway, Drinking water, Water pollution sources, Public health, Radon, Radium, Niobium, Radiation.

The radiological impact of former mining activities in the Fen area in southern Norway has been assessed. The area is known to have enhanced concentrations of Th. A recent epidemiological study suggested a significant increment of lung cancer among the former miners, and the doses to the miners have been assessed. The main contributor to the effective dose equivalent in one of the mines was inhaled Rn-220 progeny. Water in drilled wells and in nearby lakes was analyzed for Rn-220 and Ra. Uranium and Th analyses were performed on mine and lake water. The mining activity does not seem to have contaminated drinking water significantly. The tailings from Nb production has enriched Ra and Th concentrations. The tailings and the possible use of waste rock from the mining are probably the most important environmental results of the mining activities. (Author's abstract)
W86-00823

MICROBIOLOGICAL QUALITY OF RECREATIONAL WATERS IN THE PACIFIC NORTHWEST,

Environmental Protection Agency, Seattle, WA. Region X.
G. J. Vasconcelos, and N. C. Anthony.
Journal of Water Pollution Control Federation, Vol. 57, No. 5, p 366-377, May, 1985. 1 Fig, 5 Tab, 34 Ref.

Descriptors: *Water quality, *Recreational waters, *Bacteria, Washington, Oregon, Idaho, Marine environment, Water pollution sources, Coliforms, Bioindicators.

A 5-yr study of total coliforms (TC), fecal coliforms (FC), Escherichia coli, fecal streptococci (FS), enterococci, and water quality indicators at eight freshwater and two marine beaches in the Pacific Northwest (USA) revealed large variations in bacterial count and water quality. Two grab samples, one for bacteria and one for water analysis, were obtained at each of the sites, which were in or near the cities of Seattle, Spokane, and Clarkston, Washington, Eugene, Oregon, and Lewiston, Idaho. Most locations were city, county, or state parks with records of heavy bather use for at least a 4-mo summer season, and more than half of the sites were located downstream or close to wastewater treatment plant outfalls. Beaches with the highest TC and 20 C plate count (PC) organism levels were both surrounded by large residential communities subject to urban runoff. The marine beaches at Alki and Gold Gardens were relatively low in TC and PC microorganisms. In most instances FS densities determined by the KF procedure were higher than enterococci recovered by the mE procedure. Beaches with high mean values of enterococci did not always have correspondingly high mean FC values and, conversely, beaches with high FC averages did not always have a high enterococci average. Water quality criteria for Northwest recreational waters should include guidelines based on both microbial densities and an assessment of human health risks associated with the potential for disease transmission. Marine recreational waters may share the same degree of microbiological pollution as freshwater, but the potential for contact illness among swimmers is less because of lower seasonal water temperature. With the exception of water temperatures, all physical and chemical measurements made during this study were similar, regardless of location or season. The lack of variability in these measurements precludes their use in future monitoring studies. (Rochester-IVI)
W86-00840

BACTERIAL ADSORPTION AND SUSPENDED PARTICLES IN URBAN STORMWATER,

California State Univ., Northridge.
J. E. Schillinger, and J. J. Gannon.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 384-389, May. 1985. 4 Fig, 3 Tab, 28 Ref.

Descriptors: *Bacterial, *Adsorption, *Suspended particulates, *Urban runoff, Storm wastewater, Coliforms, Klebsiella, Pseudomonas, Escherichia.

Fecal coliforms collected from a stormwater drain showed significantly lower mean retention on screens (15.9%) and less sedimentation (16.8%) than did the opportunistic pathogen Klebsiella (25.7% and 33.0%, respectively) or the large group measured as Gram-negative bacteria (37.3% and 46.7%, respectively). In every case, however,

more than 50% of the stormwater bacteria were not settled or filtered (< 5 micrometer), which showed that sufficient numbers of bacteria may remain suspended in water under similar treatment conditions to pose a health hazard. These stormwater results suggest that adsorption (retention and settling) was of sufficient magnitude (average 16-47%) to warrant study of bacterial attachment and sedimentation when modeling bacterial disappearance in natural waters or treatment processes. Samples used in this study were all collected at the time of peak flow during storm events at Allen Drain, near Ann Arbor, Michigan. Most bacteria that were retained on screens were associated with particles retained on 52 micrometer or 30 micrometer screens. Nutrient agar-grown pure cultures were much less effectively adsorbed on added sediment than were broth-grown cells. The presence of fimbriae (pili) on broth-grown Escherichia coli, as shown by electron microscopy, and polysaccharide slime layers produced by Klebsiella and Pseudomonas may have affected bacterial attachment, in the first case positively, and in the second case negatively. (Rochester-IVI)
W86-00842

FACTORS AFFECTING STREAM TRANSPORT OF COMBINED SEWER OVERFLOW SEDIMENTS,

Brigham Young Univ., Provo, UT.
S. L. Klemetson.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 390-397, May, 1985. 5 Fig, 15 Tab, 20 Ref.

Descriptors: *Combined sewer overflows, *Sediment transport, *Sedimentation, Wastewater, Urban runoff, Particle size, Specific gravity, Viscosity, Density.

Wastewater and urban runoff were characterized individually, and these characteristics were extrapolated to obtain combined sewer overflow (CSO) characteristics of importance to the physical transport of CSO solids. The contribution of wastewater to the total flow may be negligible in many cases, although its effect on time-dependent changes in the CSOs may be important. Urban surface runoff makes up the majority of CSO in most cases. The characteristics of urban-surface solids may, as a first approximation, be considered similar to those of street-surface solids. In modeling the transport of CSO solids, two basic classes for processes must be considered: (1) transport depends on the quiescent settling characteristics of the solids and (2) any time-dependent changes in the settling characteristics, mass rate, or other transport variables must be included in the analysis. The variables that affect quiescent settling of discrete, non-reactive particles are particle size, specific gravity and shape, and fluid density and viscosity. These data are available from a variety of sources, and from them it is possible to generate data that may be at least representative of selected CSO solids characteristics. (Rochester-IVI)
W86-00843

MODIFICATION OF A METAL ADSORPTION MODEL TO DESCRIBE THE EFFECT OF PH,

Texas A and M Univ., College Station. Dept. of Civil Engineering.
J. L. Martin, B. Batchelor, and S. C. Chapra.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 425-427, May, 1985. 2 Fig, 10 Ref.

Descriptors: *Metals, *Adsorption, *Hydrogen ion concentration, *Mathematical models, Fate of pollutants, Model studies, Sediments, Solution equilibrium.

The Nelson metal adsorption model was modified to describe the effect of pH on adsorption apart from the value of the equilibrium constant. This approach allows easy estimates of pH effects for a wide pH range using concentration techniques for solving simultaneous chemical equilibriums. The modification of the model also allows it to be more easily extrapolated to describe adsorption in systems with different solution chemistry. The Nelson model can predict speciation at arbitrary pH values only by interpretation or extrapolation from the pH values used to calculate the conditional adsorption constant (K sub A). The modified model interprets adsorption as a competition between metal ions and protons for surface sites. This surface complex modeling approach gave reasonably good fit between measured and predicted metal adsorption onto Meuse River sediments. Alternatively, the Langmuir isotherm used in the modified model can be expressed in mass concentration units to allow calibration against experimentally determined adsorption data. This alternative formulation includes pH effects. The present modification of Nelson's model can be incorporated into equations for determining the distribution of metals among species and surfaces. This approach has been used to predict diel variations of zinc in a reservoir where predicted mixing and ligand distributions were used to analyze variability in zinc distributions. The modification also provides for the use of computer equilibrium programs to describe adsorption equilibrium while describing solution equilibrium. (Rochester-IVI)
W86-00847

VIRAL POLLUTION OF THE MARINE ENVIRONMENT,

Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
S. M. Goyal.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 1, p 1-32. 8 Fig, 13 Tab, 148 Ref. NOAA grant NA80AA-D00049.

Descriptors: *Public health, *Sludge disposal, *Ocean dumping, *Viruses, *New York Bight, Sewage outfalls, Fate of pollutants, Water pollution effects, Shellfish, Path of pollutants, Water quality standards.

Available data on the occurrence, transport, and fate of enteric viruses in the marine environment are summarized, and the viral hazards to human health associated with the disposal of sewage effluents and sludges in coastal and open ocean waters are assessed. Human enteric viruses in domestic sewage, fate and transport of viruses in the marine environment, including occurrence and survival in coastal waters, association with solids, and accumulation in shellfish, and methods for detection of viruses in water, sediment, and shellfish are described. Viruses in coastal waters have been associated with canal communities, which are very popular along the coasts of Florida, Mississippi, California, Louisiana, and Texas, with submarine offshore sewage outfalls, with disposal of dredged material from harbors, channels, and other navigable waterways, and as the direct result of sludge dumping. Viruses have been found in sediments both inside and outside the shellfish closure area in the New York Bight and at the Philadelphia disposal site, including some isolations made at the latter site 17 mo after cessation of sludge dumping. All current standards for viruses in recreational and potable water are arbitrary and reflect limitations of detection methodology for enteric viruses in water rather than disease risk. Present epidemiological methods are not adequate to gain a complete understanding of the true extent of transmission of viral disease by marine waters. (Rochester-IVI)
W86-00851

HYDROUS FE AND MN OXIDES - SCAVENGERS OF HEAVY METALS IN THE AQUATIC ENVIRONMENT,

Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
S. K. Singh, and V. Subramanian.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 1, p 33-90. 21 Fig, 33 Tab, 221 Ref.

Descriptors: *Iron oxides, *Magnesium oxides, *Heavy metals, *Coatings, *Detritus, Metals, Hydroxides, Fate of pollutants, Water pollution control, Adsorption.

The role of $Fe(OH)3$ and $MnO2$ coatings on detrital particles in the control of heavy metals in rivers and estuaries is discussed. Heavy metals in the environment, chemistry of hydrous metal oxides, heavy metals in river water, water-sediment interactions, hydroxide coatings and concretions, effects of particle size on sediment composition, and fixation of heavy metals by hydrous Fe/Mn oxides are reviewed. Mechanisms of trace metal fixation by hydrous Fe/Mn oxides are discussed, including the roles of precipitate age and organic material in uptake of heavy metals by hydrous Fe/Mn oxides. Remobilization of heavy metals, application of hydrous oxides to pollution control, heavy metals in sewage sludges, and the role of Fe/Mn oxide-mediated absorption of heavy metals in natural systems are also reviewed. Several aspects of the role of hydrous Fe/Mn oxides in regulation of heavy metals in the environment remain unknown or poorly known. These include some of the scavenging mechanisms, selectivity of the hydroxides for given elements, and the quantitative importance of coatings in relation to other sinks, notably organic coatings. The interelemental relationships among hydroxides and heavy metals suggest that hydroxides may be useful in wastewater treatment and pollution control, and the economic recovery of useful metals from hydroxide coatings may be possible. (Rochester-IVI)
W86-00852

ASBESTOS IN DRINKING WATER

Department of National Health and Welfare, Ottawa (Ontario). Health Protection Branch.
P. Toft, M. E. Meek, D. T. Wigle, and J. C. Meranger.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 2, p 151-197. 2 Fig, 11 Tab, 153 Ref.

Descriptors: *Asbestos, *Drinking water, *Public health, Transmission electron microscopy, Electron microscopy, Water pollution effects, Source of pollutants, Water treatment.

Methods of detection of asbestos in water, human exposure to asbestos in water, with emphasis on Canadian studies, and health effects of ingested asbestos are reviewed. Transmission electron microscopy with selected area electron diffraction is currently the best analytical method for determination of asbestos in drinking water. Concentrations of asbestos in drinking water range up to 2,000 million fibers/liter, but most samples analyzed have contained less than 10 million fibers/liter. 'Conventional' water treatment substantially reduces asbestos concentrations, although corrosive drinking waters may leach asbestos from asbestos-cement water mains. Epidemiological studies, all but one of which were ecological, have been insensitive and did not control for a number of potentially confounding variables. They did, however, provide some evidence for an association between ingested asbestos and cancer induction. No conclusive evidence for carcinogenicity or cocarcinogenicity of ingested asbestos has resulted from toxicological studies conducted with laboratory animals. Transmigration of asbestos fibers across the gastrointestinal wall cannot be ruled out, but there is little evidence for its widespread occurrence. The risk of developing disease from ingestion of asbestos at the concentrations found in most drinking water supplies is probably very small. Available information is insufficient to permit meaningful estimation of the magnitude of risk. (Rochester-IVI)
W86-00853

HEAVY METAL IN ISOPODS FROM THE SUPRA-LITTORAL ZONE ON THE SOUTHERN SHORE OF THE SEVERN ESTUARY, UK,

Bristol Univ. (England). Dept. of Botany.
S. P. Hopkin, M. H. Martin, and S. J. Moss.
Environmental Pollution (Series A), Vol. 9, No. 4, p 239-254, 1985. 1 Fig, 6 Tab, 48 Ref.

Descriptors: *Heavy metals, *Littoral zone, *Isopods, *Severn Estuary, *England, Zinc, Cadmium, Lead, Copper, Path of pollutants, Litter, Seaweed, Food, Smelters.

The concentrations of zinc, cadmium, lead and copper in the tissues of the littoral isopod Ligia oceanica from the three sites near to a primary zinc, lead and cadmium smelting works on the

southern shore of the Severn Estuary and an unpolluted site in the Menai Strait, Anglesey (England), were determined. The concentrations of zinc, cadmium and copper in whole L. oceanica from the contaminated sites were significantly higher than in specimens from the uncontaminated site, although the levels were only about one-and-a-half, three to four and twice as great, respectively. The amounts of lead in L. oceanica from all four sites were very small. The hepatopancreas was the most important storage organ of heavy metals and, at all sites, contained more than 50% of the total zinc, cadmium and copper in the body. The concentrations of heavy metals were compared in the tissues of L. oceanica and in two 'more terrestrial' isopods, Oniscus asellus and Porcellio scaber, collected from the same habitat at one of the contaminated sites. The mean concentrations of copper were the same in the hepatopancreas of all the isopods. However, there were large differences in the extent to which zinc, cadmium and lead had been accumulated by this organ in the three species. Analysis of the gut contents of the isopods revealed that all three species had been feeding on leaf litter derived from nearby trees, rather than on seaweed washed up onto the shore. Therefore, it was concluded that the extent to which zinc, cadmium and lead were assimilated by L. oceanica, O. asellus and Porcellio scaber must have been related to differences in their digestive physiology, rather than to choice of food material containing different concentrations of metals. (Author's abstract)
W86-00865

SORPTION OF MERCURY(II) BY HUMIC ACIDS,

Newcastle Univ. (Australia). Dept. of Chemistry.

P. Thanabalasingam, and W. F. Pickering.

Environmental Pollution (Series A), Vol. 9, No. 4, p 267-279, 1985. 3 Fig, 20 Ref.

Descriptors: *Mercury, *Fate of pollutants, *Humic acids, *Adsorption, Sediments, Hydrogen ion concentration, Calcium, Magnesium, Ammonium, Sulfates, Streams.

In a lake or closed estuary system, 90-99% of the total Hg present (predominantly inorganic species) may be associated in the sediments, with most of the residual fraction being associated with suspended particles. In experiments, uptake of Hg(II) (1-10 mg/l) by two humic acids varied with pH, with > 98% being sorbed at pH 4-5. Langmuir plots yielded adsorption capacity and bonding values of approximately 50 mmol/kg and 3,000,000 l/mol respectively. The addition of increasing amounts of chloride reduced uptake (10-20%) and shifted the maximum sorption region to higher pH values. The presence of 0.01 M levels of Ca(2+), Mg(2+) and NH4(+) promoted near total adsorption and reduced the pH effect; 0.001 levels slightly increased the amount of Hg(II) sorbed. Sulfate additions reduced Hg uptake. Much of the Hg(II) is considered to be chemisorbed, since while most of the sorbed species was extractable in 0.005 M EDTA, only half was released into 1 M HNO3 and molar salt solutions retrieved less than a third. The presence of humic acids in a sediment ensures that any added Hg(II) will become firmly bound to the solid phase, with levels in the adjacent aqueous phase being maintained at the < 50 micro-g/l level. With > 98% of any added Hg being retained, a high input rate into a natural system may result in rapid saturation of the surface of sediment beds. At the same time, with equilibrium favoring the solid phase it would seem that transport of Hg along streams will be associated mainly with suspended colloidal particles. (Moore-IVI)
W86-00866

PERSISTENCE OF ALDRIN IN FLOODED SOIL UNDER THE COVER OF RICE,

Haryana Agricultural Univ., Hissar (India). Dept. of Entomology.

G. Singh, T. S. Kathpal, K. S. Kushwaha, and G. S. Yadav.

Ecotoxicology and Environmental Safety, Vol. 9, No. 3, p 294-299, June, 1985. 2 Tab, 18 Ref.

Descriptors: *Flooded soil, *Rice, *Aldrin, Pesticide residues, Dieldrin, Fate of pollutants, Soil contamination, Flooding.

The persistence of aldrin in soil and its translocation into rice plants and grains were tested under two different field conditions. Treatment T1, which consisted of aldrin application at the rate of 1.5 kg active ingredient/ha at nursery sowing, did not leave aldrin residues in rice plants 40 days after application (10 days after transplanting). Dieldrin was present in plants to the extent of 0.04 ppm at this stage but completely disappeared (below detectable limit) within 70 days (30 days after transplanting). Treatment T2 involved aldrin application 10 days after transplanting in flooded soil at the same rate and left 0.518 ppm residues in soil just after application. These residues dissipated to their half in 90 days. At this stage its conversion to dieldrin was also observed. Remaining residues dwindled to below the detectable limit in 270 days. Plant samples analyzed from this treatment at 7 and 30 days contained 0.079 and 0.169 ppm aldrin and 0.025 and 0.08 ppm dieldrin, respectively. Rice grains also had aldrin and dieldrin residues (each at 0.001 ppm level) at harvest time but these were below the Maximum Tolerance Limits. Both the treatments were found safe from the toxic residue point of view. (Author's abstract)
W86-00875

EXAMPLE OF INTERACTION BETWEEN ENVIRONMENTAL POLLUTANTS: MODIFICATION OF THIRAM TOXICITY TO FRESHWATER ORGANISMS BY NITRITES OR NITRATES IN RELATION TO NITROSAMINE SYNTHESIS,

Rouen Univ., Mont-Saint-Aignan (France). Lab. de Toxicologie.
For primary bibliographic entry see Field 5C.
W86-00877

OCCURRENCE OF CHLORINATED POLYNUCLEAR AROMATIC HYDROCARBONS IN TAP WATER,

National Inst. for Environmental Studies, Tsukuba (Japan). Div. of Chemistry and Physics.
H. Shiraishi, N. H. Pilkington, A. Otsuki, and K. Fuwa.
Environmental Science and Technology, Vol. 19, No. 7, p 585-590, July, 1985. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Polynuclear aromatic hydrocarbons, *Chlorinated hydrocarbons, *Drinking water, Aromatic compounds, Hydrocarbons, Pollutant identification, Gas chromatography, Mass spectrometry, Chlorination, Raw water, Tsukuba, Japan.

The combination of a modified continuous liquid-liquid extraction and computerized gas chromatography/mass spectrometry using a fused silica capillary column enabled analysis of low concentrations of organic compounds in water. Tap water and raw water from Tsukuba, Japan were analyzed using this method. Monochlorinated derivatives of naphthalene, dibenzofuran, fluorene, fluorenone, phenanthrene, and fluoranthene and dichlorinated derivatives of naphthalene, phenanthrene, and fluoranthene were present in the tap water. The parent polynuclear aromatic hydrocarbons (PAHs) and their oxygenated derivatives such as fluorenone and anthraquinone were also found. Chlorinated PAHs were found in tap water at 0.1 to 0.01 ng/L levels, but were not found in the raw water. The presence of PAHs and chlorinated PAHs in tap water indicates the reaction of PAHs with residual chlorine. (Moore-IVI)
W86-00895

CARBONIZED COAL PRODUCTS AS A SOURCE OF AROMATIC HYDROCARBONS TO SEDIMENTS FROM A HIGHLY INDUSTRIALIZED ESTUARY,

Texas A and M Univ., College Station. Dept. of Oceanography.
E. G. Merrill, and T. L. Wade.
Environmental Science and Technology, Vol. 19, No. 7, p 597-603, July, 1985. 7 Fig, 2 Tab, 35 Ref.

Descriptors: *Carbonized coal products, *Hydrocarbons, *Polynuclear aromatic hydrocarbons, *Sediments, Water pollution sources, Estuarine environment, Creosote, Oil pollution, Tar, Aromatic compounds, Carcinogens, Elizabeth River, Virginia.

Sediments near large urban areas may contain high concentrations of anthropogenic hydrocarbons due to their proximity to source areas. Elizabeth River (Virginia) sediments are contaminated with high levels of hydrocarbons (0.1-2.9 mg/g). Hydrocarbon distributions in carbonized coal products (creosote, coal tar, roofing tar, and creosoted wood) were compared to that of ship stack and woodstove soot, crude oil, fuel oil, and a fuel oil spill. Hydrocarbon distributions characteristic of carbonized coal products were used to estimate the level of creosote contamination in these sediments. Elizabeth River sediments are contaminated with hydrocarbons from both carbonized coal and petroleum products. Carbonized coal products appear to have point sources associated with creosoting facility sites and are the main source of carcinogenic polynuclear aromatic hydrocarbons in the sediments. Petroleum products appear to have many sources, are highly weathered before reaching the sediments, and are the main source of the unresolved complex mixture. Carbonized coal products may contain compounds in addition to hydrocarbons (such as phenols) that may increase their environmental impact. (Moore-IVI)
W86-00896

FACTORS AFFECTING LEACHING OF NUTRIENTS FROM AN INTENSIVELY MANAGED GRASSLAND IN COUNTY ANTRIM, NORTHERN IRELAND,

Department of Agriculture for Northern Ireland, Antrim. Freshwater Biological Investigation Unit.
C. Jorden, and R. V. Smith.
Journal of Environmental Management, Vol. 20, No. 1, p 1-15, January, 1985. 4 Fig, 4 Tab, 32 Ref.

Descriptors: *Leaching, *Nutrients, *Grasslands, *Northern Ireland, Nitrogen, Phosphorus, Drainage, Grazing, Particulate matter, Nitrates, Ammonium, Manure, Pasture management.

Losses of nitrogen and phosphorus from intensively managed grassland were monitored daily. Cluster and factor analysis of the weekly loadings of the various nitrogen and phosphorus fractions indicated that the data could be divided into two main groups of variables. The first group included flow, soluble kjeldahl nitrogen and nitrate nitrogen; the second group included soluble reactive phosphorus, soluble organic phosphorus and ammonium nitrogen. Particulate phosphorus and particulate kjeldahl nitrogen shared some characteristics of both groups, but tended to be more similar to group two above. The loadings of the nitrogen fractions in the first group were principally determined by the flow through the drain - an increase in flow led to a proportionate increase in the loadings of soluble kjeldahl and nitrate nitrogen. Slurry (liquid manure) application and grazing during periods when the soil was close to saturation led to much larger losses of soluble reactive phosphorus, soluble organic phosphorus, ammonium nitrogen, particulate kjeldahl nitrogen and particulate phosphorus, than losses of soluble kjeldahl nitrogen and nitrate nitrogen. Slurry applications, silage cuts and grazing during dry periods led to negligible losses of nitrogen and phosphorus. Greatest losses of nitrate occurred after heavy rainfall following prolonged dry periods and were particularly evident in the autumn of 1982 and winter of 1983-84. (Author's abstract)
W86-00903

FACTORS INFLUENCING HYDROCARBON DEGRADATION IN THREE FRESHWATER LAKES,

Massachusetts Univ. at Boston. Environmental Science Program.
J. J. Cooney, S. A. Silver, and E. A. Beck.
Microbial Ecology, Vol. 11, No. 2, p 127-137, 1985. 1 Fig, 6 Tab, 14 Ref. OWRT grant B-060.

Descriptors: *Microbial degradation, *Lakes, *Fate of pollutants, *Hydrocarbons, Water pollution, Naphthalene, Pristane, Tetradecadiene, Hexadecane, Kerosene, Lake sediments, Limiting nutrients, Dissolved oxygen, Oil pollution, Water temperature, Bacteria.

The mixed microbial flora of 3 lakes on Ohio with differing histories of hydrocarbon pollution was examined in relation to the ability to use hydrocarbons. Weathered kerosene was spiked with naphthalene, pristane, 1,13-tetradecadiene, and n-hexadecane and added to water-sediment mixtures from the 3 lakes, and utilization of the 4 marker hydrocarbons was measured. Each of the marker hydrocarbons was metabolized; naphthalene was the most readily used and pristane was the most resistant. Values for dissolved oxygen suggest that oxygen did not limit hydrocarbon degradation in the water column at any site examined. Nutrient addition studies indicated that nitrogen and phosphorus limited hydrocarbon degradation at all sites examined. Maximum numbers of heterotrophic bacteria were detected when the water temperature was 10 C or higher. The data indicate that temperature limits hydrocarbon degradation in the winter, except at a site which had beem impacted by an oil spill and which received chronic inputs by hydrocarbons and nutrients. In samples from that site, all 4 markers hydrocarbons were degraded at 0 C. Results of temperature and nutrient-addition experiments suggest that different seasonal populations of hydrocarbon users are selected at that site, but not at other lake sites. (Author's abstract)
W86-00909

COPPER TOXICITY TO CYANOBACTERIA AND ITS DEPENDENCE ON EXTRACELLULAR LIGAND CONCENTRATION AND DEGRADATION,

Liverpool Univ. (England). Dept. of Botany.
W. F. Jardim, and H. W. Pearson.
Microbial Ecology, Vol. 11, No. 2, p 139-148, 1985. 4 Fig, 26 Ref.

Descriptors: *Plectonema, *Copper, *Toxicity, *Ligands, Metals, Cyanophyta, Citrate, Nitrilotriacetic acid, Fate of pollutants, Biodegradation, Algae, Microorganisms.

In the environment, the amelioration of the toxic effects of ionic copper can be due to the complexation by naturally occurring ligands. Copper toxicity to the cyanobacterium Plectonema boryanum (UTEX 594) was investigated in the presence of citrate and nitrilotriacetic acid (NTA) using a copper-saturated culture medium. The copper-citrate complex was biodegradable, and toxicity was dependent on the free ligand concentration. The ratio of citrate to copper also affected the extent of metal toxicity. NTA was not degraded by P. boryanum. Ligand degradation in the cyanobacterial culture increased the ionic copper concentration and caused a concomitant reduction in growth. Care must be taken when choosing complexing compounds to be used in metal toxicity tests involving microorganisms, since if the compounds are degraded, conditions will alter markedly during the course of the experiment. The bioavailability of citrate (and thus presumably other organic ligands), even when strongly complexed by metals, has ecological implications. Consumption of the ligand by heterotrophs may increase metal toxicity by increasing the ionic concentration, and this may actually coincide with a decrease in the soluble metal concentrations. (Moore-IVI)
W86-00910

5C. Effects Of Pollution

EFFECTS OF TREATED SEWAGE EFFLUENT AND BAY-BOTTOM MUD ON GROWTH OF MARINE PHYTOPLANKTON,

K. Kobayashi, N. Imada, and Y. Oshima.
Science Bulletin of the Faculty of Agriculture, Kyushu University, Vol. 39, No. 4, p 143-151, March, 1985. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Eutrophication, *Wastewater pollution, *Phytoplankton, *Estuarine environment, *Bays, *Sediments, Nitrogen, Phosphorus, Water pollution effects, Coastal waters, Mud.

As nitrogen and phosphorus sources, the treated sewage effluent and the bay-bottom and mud promote the eutrophication of estuarial and coastal areas, especially closed bays. The present paper deals with the effects of the treated sewage effluent and the bay-mud exudate on the growth of various phytoplankton species present in natural sea water. 1. Five sampling stations were set in the area receiving the effluent from Fukuoka Eastern Sewage Disposal Plant. 2. Throughout six investigations from May to November in 1979, the major phytoplankton occurring at the sampling stations were nine species of Bacillariophyceae and one of Dinophyceae. 3. In summer, the surface water in eastern Hakata Bay was extremely deficient both N and P or N, especially at the bottom of phytoplankton. 4. The average concentrations of NH4-N, NO3-N, NO2-N, org. N, PO4-P and org. P of the treated sewage effluents used for the N, P enrichment of media were 19.2 3.71, 0.1, 0.94, 2.64 and 0.20 mg/l, and those of bay-mud exudates were 20.8, tr., tr., 1.47, 3.35 and 0.49 mg/l, respectively. 5. In the N, P enriched media with NP-water (NO3-N, 16 mg/l; PO4-P, 2 mg/l), the cell number of almost all phytoplankton species seeded with natural sea water increased with increasing N, P concentrations of the media. In the media enriched with the treated sewage effluent and the bay-mud exudate, however, the growth of most phytoplankton species except Skeletonema costatum and Thalassiosira sp. were inhibited with increasing concentrations of the sewage effluent and the bay-mud exudate in the media. 6. The difference of susceptibility among phytoplankton species to some growth inhibitors which are contained in the sewage effluent and released from the bay-bottom mud may be a factor causing some dominant species in the plankton community. (Author's abstract)
W86-00616

REPLACEMENT OF STENONEMA SPP. BY CAENIS DIMINUTA WALKER AS THE NUMERICAL DOMINANT IN THE MAYFLY ASSEMBLAGE OF A THERMALLY-STRESSED STREAM,

Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
N. L. Poff, and R. A. Matthews.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 19-26, June, 1985. 3 Fig, 1 Tab, 26 Ref. DOE contract DE-AC09-76SR00001.

Descriptors: *Mayflies, *Thermal pollution, *Species composition, Water pollution effects, Aquatic insects, Streams, Heated water, Effluent.

Mayfly community structures in a thermally-stressed, previously thermally-stressed and an undisturbed stream were compared based on nymphal colonization of leaf packs incubated over a 48 d period from December 1982 to February 1983. Temperatures ranged from 7-31 C in the thermally-stressed stream and from 4-12 C in the other two streams. Accumulated degree days (>OC) were 734, 340 and 322 for the thermally-stressed, post-stressed and undisturbed streams, respectively. Stenonema spp. numerically dominated the mayfly fauna over the sampling period in the undisturbed (70%) and post-stressed (98%) streams, but was replaced by Caenis diminuta Walker (88%) in the stream receiving thermal effluent from a nuclear production reactor. Caenis diminuta is tolerant of rapidly fluctuating (delta T > 11 C/hr) and high temperatures (possibly up to 40 C). (Author's abstract)
W86-00617

EFFECTS OF SEWAGE ON LAKE CHAMPLAIN WETLAND,

Florida Univ., Gainesville. Center for Wetlands.
L. N. Schwartz, and G. K. Gruendling.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 35-46, June, 1985. 1 Fig, 5 Tab, 33 Ref.

Descriptors: *Wastewater pollution, *Wetlands, *Water pollution effects, *Productivity, Food chain, Trophic level, Phytoplankton, Nutrients, Bacteria, Particulate matter, Lake Champlain, New York, Vermont.

Stevens Brook wetland is presently receiving partially treated sewage from the City of St. Albans, Vermont. The water quality in St. Albans Bay is deteriorating. There is conflicting evidence for the theory that wetlands act as a nutrient sink or as a biotic nutrient filter. This research is an investigation into the productivity and trophic food chain relationships of Stevens Brook wetland. This is compared to a non-impacted area, Scomotion Creek Wetland in Plattsburgh, New York. Temperature, pH, dissolved oxygen, transparency, alkalinity, conductivity, sodium, potassium, calcium, magnesium, nitrate, total phosphorus, bacteria, phytoplankton, aquatic macrophytes, and benthic invertebrates were sampled in both wetlands. The data indicate that excessive nutrients and a large carbon source result in high phytoplankton productivity and bacterial growth. This coupled with particulate matter causes low transparency and thus a decrease in submergent vegetation and a decrease in invertebrate faunal diversity. Increased production is not converted to additional biomass of consumers but is exported to the downstream water body. Thus, Stevens Brook wetland appears to be a pass-through system rather than a storage system, and is not effective in tertiary treatment of sewage effluent. (Author's abstract)
W86-00619

DISTRIBUTION OF ALUMINUM IN THE TISSUES OF THREE FISH SPECIES,

Northwestern State Univ. of Louisiana, Natchitoches. Dept. of Biological Sciences.
D. J. Berg, and T. A. Burns.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 113-120, June, 1985. 5 Tab, 18 Ref.

Descriptors: *Aluminum, *Fish, *Alum, *Water pollution effects, Chaplin Lake, Louisiana, Water treatment wastes, Effluents, Catfish, Shad, Largemouth bass.

The use of alum (aluminum sulfate) to decrease the turbidity of public drinking water is a common practice in Louisiana. Alum acts as a source of positive electrolytes which neutralize negatively-charged soil particles, causing them to settle out of the water and produce a gelatinous sludge. Natchitoches, Louisiana pumps approximately 900 kg of such sludge into Chaplin Lake each day. Tissue aluminum levels in channel catfish, gizzard shad and largemouth bass were compared between Chaplin Lake, which receives water treatment plant effluent containing alum and a control lake. No significant correlations were found between tissue aluminum levels and age. Significant negative correlations were found between channel catfish brain and gill aluminum levels in individuals from Chaplin Lake and between gizzard shad brain aluminum levels and standard length. Liver and brain tissues had higher tissue aluminum concentrations than muscle and gill tissues. (Moore-IVI)
W86-00621

INFLUENCE OF OIL REFINERY EFFLUENTS ON THE STRUCTURE OF ALGAL COMMUNITIES,

Udai Pratap Coll., Varanasi (India).Dept. of Botany.
J. P. Gaur, and H. R. Kumar.
Archiv fur Hydrobiologie, Vol. 103, No. 3, p 305-323, May, 1985. 3 Fig, 10 Tab, 44 Ref.

Descriptors: *Water pollution effects, *Refineries, *Industrial wastes, *Algae, Species composition, Algal growth, Wastewater treatment, Plankton, Oil pollution, Phenols.

A survey of algal vegetation and chemical characteristics of wastewaters of Barauni, Gauhati, Gujarat, Madras and Cochin (India) refineries at different stages of treatment was made to have some ideas about the changes in algal community structure along the gradient of decreasing pollution load. During the initial stages of effluent treatment, effluents had high concentrations of oil and phenol as a result of which BOD and COD values were quite high. Several species of Oscillatoria and Phormidium were the sole contributors to total abundance of algal communities in the primary

treatment ponds. Diversity index was around 1 during the initial stage of treatment in oil separator tanks or clariflocculators. With the removal of phenol and oil and lowering of BOD and COD values, some representation of other algae occurred after the passage of effluent through various treatment processes. In conjunction with increase in species number up to the last treatment stage, there was a consistent decrease in apportionment of individuals in each species resulting in high (<3) diversity index at the outfall or the last treatment stage. Selected refineries showed marked resemblance in algal community structure despite the fact that they use different crude oils for refining operations and also different effluent treatment processes, and are located in different states of the country. The algal communities respond in a more or less predictable manner to severe stress of oil pollution. (Baker-IVI)
W86-00623

IN VITRO EFFECT OF MERCURIC CHLORIDE ON ACID AND ALKALINE PHOSPHATASE ACTIVITY OF A FRESHWATER PRAWN,

D.A.V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab.
R. Murti, Omkar, and G. S. Shukla.
Archiv fur Hydrobiologie, Vol. 103, No. 3, p 371-374, May, 1985. 2 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Mercuric chloride, *Alkaline phosphatase, *Acid phosphatase, *Prawn, Toxicity, Heavy metals, Mercury compounds.

In vitro experiments were conducted to investigate the effects of mercuric chloride on acid and alkaline phosphatase activity in different tissues of freshwater prawn. Mercury was quite effective, inhibiting the activities of acid and alkaline phosphatases. The degree of inhibition increased with an increase in the concentration of the toxicant. Maximum inhibition in acid phosphatase activity was observed in 0.285 mg/l of mercuric chloride in hepatopancreas as compared to control whereas minimum inhibition was observed in the muscle (13%) after treatment with 0.095 mg/l HgCl2. Alkaline phosphatase activity was inhibited maximum in the stomach (33%) and minimum in the gill (10%) in 0.295 and 0.095 mg/l solutions respectively. In brain no significant inhibition in activity of alkaline phosphatase was noted. Maximum inhibition in acid phosphatase was noted in hepatopancreas (48%). It is concluded that alteration in the activities of these two phosphatases creates disturbances in the normal functioning of the various tissues of M. lamarrei. (Baker-IVI)
W86-00625

EFFECT OF PH ON TOXICITY OF SODIUM PENTACHLOROPHENATE TO FRY OF COMMON CARP IN SOFTWATER,

Delhi Univ. (India). Dept. of Anthropology.
B. S. Khangarot, A. Sehgal, and M. K. Bhasin.
Archiv fur Hydrobiologie, Vol. 103, No. 3, p 375-379, May, 1985. 1 Tab, 23 Ref.

Descriptors: *Water pollution effects, *Carp, *Toxicity, *Sodium pentachlorophenate, *Hydrogen ion conncentration, Organic compounds, Industrial wastes, Pesticides, Fish, Immature growth stages.

Pentachlorophenol and its salts, especially sodium pentachlorophenate (Na-PCP) are used extensively in industry and agriculture as fungicides, bactericides, insecticides and herbicides. Because of their widespread use, these pollutants ultimately reach to the aquaitc ecosystem and create water pollution problems. The acute toxicity of Na-PCP to fry of common carp was examined for 96 hr during bioassay tests. The influence of pH on toxicity of Na-PCP was examined for 48 hr. Most mortality from Na-PCP occurred within the 12 hr period. Immediately upon the introduction of Na-PCP fish showed hyperactivity. The behavioral responses of fry varied according to test concentration and pH. At lower pH, test concentrations are more toxic therefore, test animal showed more behavioral changes as compared to similar higher pH test concentration. In general fry responded to Na-PCP by an increase in swimming activity, surfacing, loss of schooling and equilibrium followed by swimming belly up and finally settling to the bottom before death. At higher pH concentrations fish were not affected until a few hours before death. (Baker-IVI)
W86-00626

EFFECTS OF AVAILABLE DIETARY CARBOHYDRATE AND WATER TEMPERATURE ON THE CHRONIC TOXICITY OF WATERBORNE COPPER TO RAINBOW TROUT (SALMO GAIRDNERI),

Waterloo Univ. (Ontario). Dept. of Biology.
D. G. Dixon, and J. W. Hilton.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 5, p 1007-1013, May, 1985. 5 Tab, 29 Ref.

Descriptors: *Copper, *Toxicity, *Trout, *Diets, *Carbohydrates, *Water temperature, Heavy metals, Acclimation, Fish, Growth, Mortality.

A factorial design was used to determine the effects of dietary carbohydrate content (0.1 or 25.6%) and temperature (10 or 15 C) on the chronic toxicity of waterborne copper (0 or 144 micro-g Cu/L) to rainbow trout (Salmo gairdneri) over a 12-wk period. Relative to those on the low-carbohydrate (LC) diet, trout reared on the high-carbohydrate (HC) diet developed enlarged, glycogen-filled livers and attained reduced final mean wet body weights. This response was more pronounced at 10 than at 15 C. Whereas Cu exposure had no significant effect on the growth or mortality of either LC or HC fish at 15 C, or LC fish at 10 C, HC fish at 10 C showed significantly reduced final weight and increased mortality. Trends toward reduced liver glycogen and increased serum glucose, characteristic of chronic stress, were apparent in all Cu-exposed fish. In Cu-free water, mean Cu concentrations in liver tissue of HC fish were significantly lower than those in LC fish at both temperatures. Copper exposure resulted in significant increases in liver Cu concentration for all diet treatments except HC at 10 C. Elevated serum sorbitol dehydrogenase levels, indicative of hepatic damage, were apparent in Cu-HC fish at 15 C and in HC, Cu-HC, and Cu-LC fish at 10 C. No treatment effects on either serum protein or hematocrit were evident. The treatments during the growth period affected subsequent lethal tolerance of Cu. While the 96-h Cu LC50 was not significantly altered by diet alone at 15 C, it was elevated in HC fish, relative to LC fish at 10 C. The Cu LC50 of Cu preexposed fish was significantly elevated, relative to parallel groups held in Cu-free water, for LC fish at both 10 and 15 C. This acclimation to Cu was not apparent in HC fish at either temperature: no significant elevation in LC50 occurred as a result of preexposure. It is concluded that increased dietary carbohydrate can significantly increase the chronic toxicity of Cu to trout, and that the impact is enhanced by reduced water temperature. (Author's abstract)
W86-00630

BACTERIOLOGICAL SURVEY OF TWO ACID-STRESSED LAKES IN THE POCONOS BEFORE LIMESTONE APPLICATION,

Lafayette Coll., Easton, PA. Dept. of Biology.
S. K. Majumdar, G. Rall, A. Mrowca, P. Steed, and J. Tabak.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 2, p 181-186, 1984. 7 Tab, 26 Ref.

Descriptors: *White Deer Lake, *Bruce Lake, *Pennsylvania, *Acid rain, *Water pollution effects, *Bacteria, Lake sediments, Lakes, Water analysis, Water temperature, Seasonal variation, Sulfur bacteria.

Water and sediment samples were examined from two acidified lakes (White Deer, water pH range 4.4-6.6, and Bruce Lake, water pH range 5.9-6.6) in the Pocono Mountains of Pennsylvania to assess the impact of acid-stressed conditions on bacterial communities and densities prior to neutralization. Temperature values in water ranged from a low 9.5 in November to a high of 27.6 degrees C in June. In general, for both lakes, as the day length and temperature increased, pH values increased and bacterial populations, in most cases, increased. Bacterial counts during the summer and early fall months were elevated for all types of bacteria, except for the Pseudomonas types which remained consistently low throughout. The bacterial densities showed a seasonal pattern. The nitrogen cycle and sulfur cycle bacteria recovered from the spot plate method and the most probable number procedure, showed variations in total bacterial numbers in the water and sediment samples of both White Dear Lake and Bruce Lake. The Pseudomonas bacteria in both lakes were low at all four sediment sites. The sulfur cycle bacteria recovered by the MPN method also reflected low numbers. The sulfur reducers are found in a moderate amount ranging from 400 to 52,000 cells per ml of sediment slurry, while the sulfur oxidizers of the thio-oxidans group which favor a lower pH are not as prevalent, ranging from a low of 15 in November to a high of 10,000 cells per ml in June. The two acid stressed lakes in the Poconos are somewhat similar in bacterial communities and densities. The total bacterial flora present in the two lakes were markedly lower than those found in other non-acid-stressed lakes. (Baker-IVI)
W86-00634

RESPONSE OF A DETRITAL FOODWEB TO EUTROPHICATION,

Marine Biological Lab., Woods Hole, MA.
J. E. Hobbie, and J. J. Cole.
Bulletin of Marine Science, Vol. 35, No. 3, p 357-363, November, 1984. 7 Fig, 1 Tab, 18 Ref.

Descriptors: *Food chains, *Eutrophication, *Detritus, Bacteria, Protozoa, Marine environment, Plankton, Nutrients, Nitrogen, Phosphorus, Silica, Biomass, Primary productivity.

The response of planktonic bacteria and microprotozoa to an experimental eutrophication gradient in coastal marine waters was investigated. Bacterial and microflagellate numbers, as well as glutamic acid mineralization and tritiated thymidine incorporation, were measured in a series of 13 cu m mesocosms for 6 months. The systems received a daily addition of sea water (3.7% of total) and nutrients so that the nutrients added were 0, 2, 4, 16 and 32 times the anthropogenic nitrogen, phosphorus and silica loading of Narragansett Bay, Rhode Island. Both the biomass and primary production of the planktonic algae increased in direct response to nutrient loading through the 16x treatment; the response in the 32x treatment equalled that of the 16x treatment. In general, bacterial numbers and growth (calculated from thymidine uptake) were higher in the more eutrophic tanks but there were lags in the microbial response to the peaks and valleys of the algal growth. These lags caused poor correlation between instantaneous measurements of microbial and algal parameters such as numbers of bacteria and algal production. However, when daily production was summed for the entire 6 months of the study there was excellent correlation between the total algal production and the total bacterial production ($r = 0.89$) for six tanks. It is difficult to convert from thymidine incorporation to absolute quantities of bacterial production. A conservative conversion factor derived from laboratory values for the thymidine content of bacterial cells was used to calculate bacterial production. Bacterial production (respiration plus growth) was nearly a constant fraction of planktonic primary production at all levels of eutrophication and averaged 31%. The results are in good agreement with other estimates of the carbon flux through the detrital component of pelagic ecosystems. (Author's abstract)
W86-00638

MACROBENTHIC INVERTEBRATES OF A PERTURBED STREAM IN SOUTHERN NIGERIA,

Benin Univ., Benin City (Nigeria). Dept. of Zoology.
R. Victor, and D. T. Dickson.
Environmental Pollution (Series A), Vol. 38, No.

21 p 99-107, 1985. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Invertebrates, *Benthic fauna, *Ikpoba River, *Nigeria, Stress, Oligochaetes, Chironomids, Water pollution effects, Wastewater pollution, Storm runoff, Aquatic insects.

The Ikpoba River is a fourth order stream flowing from north to south through Benin City, Bendel State, Southern Nigeria. In its upper reaches, the stream flows through a dense rainforest where surface run-off and organic matter from the surrounding vegetation contribute to allochtonous input. In the outskirts of the city, riparian settlements are thinly populated, so that disturbance due to human activities is low and localized. The stream is considerably perturbed while flowing through the city. The University of Benin and its Teaching Hospital discharge sewage sludge into forest clearings near the right bank and at least part of these effluents are likely to enter the stream via runoff and seepage. It also receives stormwater runoff from bordering agricultural lands and urbanized areas. The Ikpoba weir impounds the stream further downstream to form an artificial reservoir. A total of nine taxa were collected in the study stretch. The insects were represented by larvae or nymphs of six families: Chironomidae, Ceratopogonidae, Baetidae, Hydroptilidae, Parnidae and Corduliidae. The oligochaetes were represented by one family, Naididae. The most striking feature of the study area is the overall low diversity of macrobenthic invertebrates. The abundance of macrobenthos in the three stations was variable. The important factors governing the occurrence and distribution of macrobenthos are the physicochemical qualities of the water and the immediate substrate of occupation. Any severe alterations of these factors will substantially affect the macrobenthos. The combination of substrate obliteration and poor water quality, especially the low dissolved oxygen content seem to be controlling the macrobenthos in some instances. (Baker-IVI)
W86-00652

TOXIC EFFECTS OF IRON ORE TAILINGS AND THE RESPONSE OF WATERCRESS FROM TAILINGS AT HIGH CONCENTRATIONS OF FE, ZN AND MN,

Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
M. H. Wong.
Environmental Pollution (Series A), Vol. 38, No. 2, p 129-140, 1985. 6 Fig, 5 Tab, 14 Ref.

Descriptors: *Mine wastes, *Manganese, *Zinc, *Iron, *Watercress, Seeds, Metals, Plants, Water pollution effects, Aquatic plants.

The vegetation growing on iron ore tailings is subject to a harsh environment, especially various adverse edaphic factors including the rather high contents of Mn, Fe and Zn. N. officinale (watercress) grows in waterlogged areas with its roots penetrating into the soil and part of the plant body submerged in water. The ability of N. officinale growing in iron ore tailings to produce plants tolerant to the comparatively high metal concentrations was investigated. Samples of watercress were collected from the tailings site, a cultivated area and noncultivated land. Metals present in plant tissue collected from the tailings were significantly higher than those collected from the other sites. Studies showed that 5, 10, and 15% water extracts of soil from the three sites reduced Brassica chinensis seed germination and root elongation. When the three different populations of N. officinale collected from the three sites were tested from metal tolerance by examination of root growth in a series of concentrations of manganese, iron and zinc separately, it was found that the tailings population had significantly higher values of tolerance for each of the three metals despite the fact it had only been growing on the site for three years. (Baker-IVI)
W86-00653

METHOD FOR AQUATIC MULTIPLE SPECIES TOXICANT TESTING: ACUTE TOXICITY OF 10 CHEMICALS TO 5 VERTEBRATES AND 2 INVERTEBRATES,

Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5A.
W86-00654

FATE AND EFFECTS OF ORGANOTIN COMPOUNDS,

California Univ., Berkeley. Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W86-00665

DESTRUCTION OF WATER RESOURCES - THE MOST CRITICAL ECOLOGICAL CRISIS OF EAST ASIA,

International Union for Conservation of Nature and Natural Resources, New Delhi (India).
For primary bibliographic entry see Field 4C.
W86-00666

ALLIUM TEST ON RIVER WATER FROM BRAAN AND SAXAN BEFORE AND AFTER CLOSURE OF A CHEMICAL FACTORY,

Lund Univ. (Sweden). Inst. of Genetics.
For primary bibliographic entry see Field 5A.
W86-00667

GROWTH INHIBITION AND RECOVERY IN MUSSELS (MYTILUS EDULIS) EXPOSED TO LOW COPPER CONCENTRATIONS,

University Coll. of North Wales, Menai Bridge. Marine Science Labs.
K. J. Redpath.
Journal of the Marine Biology Association, Vol. 65, No. 2, p 421-431, 1985. 7 Fig, 1 Tab, 23 Ref.

Descriptors: *Copper, *Water pollution effects, *Mussels, *Animal growth, Heavy metals, Industrial wastes, Toxicity, Growth, Metals, Animal metabolism.

The shell growth of Mytilus edulis was investigated under the effects of a 10 day exposure to copper at six different concentrations. At concentrations greater than 2 micro g/l added copper, significant growth inhibition occurred. At 15 micro g/l added metal, growth almost ceased. At 6 micro g/l a 50% reduction of growth was noted. After the exposure period was completed, recovery was observed at all concentrations. The long term recovery pattern of Mytilus shell growth was studied after a 20 day exposure to copper also. Evidence was found of a growth overshoot after then end of the exposure period. The known effects of copper on the metabolism of mussels is included in the discussion of these findings. (Baker-IVI)
W86-00668

LONG-TERM ECOSYSTEM STRESS: THE EFFECTS OF YEARS OF EXPERIMENTAL ACIDIFICATION ON A SMALL LAKE,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
D. W. Schindler, K. H. Mills, D. F. Malley, D. L. Findlay, and J. A. Shearer.
Science, Vol. 228, No. 4706, p 1395-1401, June 1985. 2 Fig, 45 Ref.

Descriptors: *Water pollution effects, *Acid rain, *Lakes, *Acidification, *Ecosystems, Environmental effects, Fish, Food chains, Acidity, Water quality, Hydrogen ion concentration, Ontario.

An ecosystem scale experiment was conducted in Lake 223, a small Precambrian Shield lake surrounded by virgin boreal forest in the Experimental Lakes Area, and typical of poorly buffered small lakes of northwestern Ontario. Over a period of 8 years, the pH of the lake has been gradually decreased from 6.8 to 5.0 by the addition of sulfuric acid. The study revealed various apparent mechanisms of response of the lake's biota to increased acidity, ranging from direct toxicity of hydrogen ion to disruptions of normal food-chain relations, behavioral patterns of animals, and biogeochemical cycles in the lake. In some cases, synergistic interactions of several stresses appeared to be involved. Some of the adverse changes occurred much earlier in the acidification process than is commonly believed to cause ecosystem degradation. This suggests that ecological damage from lake acidification may be more extensive than previously believed. Changes in phytoplankton species, cessation of fish reproduction, disappearance of the benthic crustaceans, and appearance of filamentous algae in the littoral zone were consistent with deductions from synoptic surveys of lakes in regions of high acid deposition. Acidification did not cause decreases in primary production, rates of decomposition, or nutrient concentrations. Key organisms in the food web leading to lake trout, including Mysis relicta and Pimephales promelas, were eliminated from the lake at pH values as high as 5.8, an indicate that irreversible stresses occur early in the process. These changes are caused by hydrogen ion alone, and not by the secondary effect of aluminum toxicity. Since no species of fish reproduced at pH values below 5.4, the lake would become fishless within about a decade on the basis of the natural mortalities of the most long-lived species. (Baker-IVI)
W86-00688

METABOLISM OF ALDRIN BY THE FRESHWATER PLANARIAN PHAGOCATA GRACILIS,

Middle Tennessee State Univ., Murfreesboro. Dept. of Biology.
S. Post, and M. R. Wells.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 871-875, June, 1985. 1 Tab, 8 Ref.

Descriptors: *Aldrin, *Planaria, *Animal physiology, *Toxicity, Water pollution effects, Enzymes, Dieldrin, Chlorinated hydrocarbons, Pesticides, Insecticides.

Planarians (Phagocata gracilis) that were fed beef liver containing 125 ppm aldrin showed no ill effects and appeared to convert the pesticide to an unidentified hydrophilic compound, not to dieldrin. Planarians sacrificed at 40 min after feeding for 1 hr contained the highest level of aldrin (1.12 + or - 0.99 ppm). Neither dieldrin nor any other insecticide was recovered from tissue. After planarians were removed from the feeding dishes, an unidentified hydrophilic compound, which eluted after 5.35 min from a Varian model 3700 gas chromatograph packed with 11% OV-17+QF, by wt (80/100) on Gas Chrom Q. The compound was recovered from water samples of 2/3 groups sacrificed at 120 min and 3/3 groups sacrificed at 180 min. No aldrin epoxidase activity was detected in any subcellular fraction assayed. P. gracilis does not appear to convert aldrin to dieldrin. The hydrophilic compound detected in water samples from animals treated with aldrin suggests an alternate route of detoxification; this mechanism avoids the formation of another toxic compound by converting aldrin directly into a polar metabolite that is readily excreted into their aquatic environment. (Rochester-IVI)
W86-00693

PCBS IN STRIPED BASS COLLECTED FROM THE HUDSON RIVER, NEW YORK, DURING FALL, 1981,

State Univ. of New York at Albany. Dept. of Atmospheric Science.
R. J. White, H. T. Kim, and J. S. Kim.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 883-889, June, 1985. 2 Tab, 13 Ref.

Descriptors: *Polychlorinated biphenyls, *Hudson River, *New York, *Bass, *Fish, Bioaccumulation, Water pollution effects, Chlorinated hydrocarbons.

Analyses of striped bass (Morone saxatilis) filets from the Hudson River near Nyack, New York contained a mean concentration of polychlorinated biphenyls (PCBs) higher than 2 ppm. Comparison of peak to peak summation and pattern matching showed that the two techniques gave equivalent results. Trimming fish filets, by removing the skin and adipose tissue, resulted in significantly lower concentrations of PCB (1.3 + or - 0.6 micro-g/g wet weight versus 3.0 + or - 1.8 micro-g/g for the standard filets) from the same fish. Similar results

were obtained for hexane-extractable lipids. No correlation could be established between length of fish and PCB concentration. Trimming of filets reduced the average (but not all individual) tissue concentrations of PCBs to below the 2 ppm limit of safety established by the Food and Drug Administration. It is recommended that anglers employ the trimming procedure and limit the number of fish consumed. (Rochester-IVI)
W86-00695

EFFECTS OF CADMIUM AND COPPER ON CHEMOTAXIS OF MARINE AND FRESHWATER CILIATES,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
S. G. Berk, J. H. Gunderson, and L. A. Derk.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 897-903, June, 1985. 2 Tab, 16 Ref. U.S. EPA grant R809799.

Descriptors: *Protozoans, *Copper, *Cadmium, *Chemotaxis, *Animal behavior, *Water pollution effects, Metals, Heavy metals, Toxicity.

The chemotactic response of both freshwater and marine ciliates was affected by the presence of relatively low concentrations of copper or cadmium in the water. Ciliates (Tetrahymena sp., freshwater; Paranophrys sp., an unknown designated W5, and Maimiensis avidus; all marine) were allowed to seek yeast extract solution in capillary tubes, and the number of ciliates entering the tubes was measured. Copper caused swimming speed to increase, which gave the impression of stimulated chemotaxis, but in fact led to non-linear log-probit graphs for EC50, yielding meaningless values in some cases. Significant inhibition of chemotaxis was given by copper at 0.0050-0.25 ppm (Miamensis), 0.05-0.10 ppm (Paranophrys), 0.05-1.0 ppm (W5), and 0.25-1.00 (Tetrahymena) and by cadmium at 0.25-1.00 ppm (Tetrahymena), 4.0-25.0 ppm (Paranophrys), 5.0-25.0 (W5), and 10.0-25.0 ppm (Miamiensis). Copper was apparently more toxic than cadmium for marine ciliates, and the metals were equally toxic for the freshwater species. The inhibitory effects on Miamiensis of 15 min exposure to 0.5 ppm Cu were eliminated by washing the cells; similarly, the effects of Cd could be reversed by washing. Washing Tetrahymena did not eliminate the effects of exposure to 0.25 ppm Cu, but did nullify the effect of 1 ppm Cd. Sublethal concentrations of certain heavy metals in the natural environment may cause population reduction or elimination because animals become unable to locate areas of high food concentration. (Rochester-IVI)
W86-00696

TOXICITY AND ACCUMULATION OF COPPER AND CADMIUM IN THE ALGA SCENEDESMUS OBLIQUUS LH,

Vysoka Skola Zemedelska v Praze, Ceske Budejovice (Czechoslovakia). Faculty of Agricultural Economics and Management.
K. Drbal, K. Veber, and J. Zahradnik.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 904-908, June, 1985. 2 Tab, 12 Ref.

Descriptors: *Algae, *Scenedesmus, *Toxicity, *Bioaccumulation, *Copper, *Cadmium, Metals, Heavy metals, Water pollution effects, Chemical reactions.

Scenedesmus obliquus LH removes both Cu and Cd from an aquatic medium, but actual bioabsorption appears to be much lower than measured changes of the metals in the cultivation media. Initial experiments showed a removal efficiency of 83-97% for Cu and 78-99% for Cd when calculated on the basis of amount of heavy metal remaining in the supernatant medium. In parallel experiments without algae and without light, however, removal of 47-56% Cu and 61-78% Cd was observed, indicating that purely chemical precipitation accounted for much of the observed removal of metals. Studies conducted over periods ranging from 0.5-120 or 144 hr showed that removal efficiency generally increased between 0.5 and 24 hr for both metals in all experiments, but did not necessarily increase with increasing time after that. In all series, the removal efficiency at 120 or 144 hr was less than values attained at shorter times. The presence of 0.5 mg/l of each metal in the medium produced less inhibition of biomass accumulation over time than did 1 mg/l of each metal in the culture. Microscopic examinations showed no death of algal cells at either concentration in experiments lasting up to 144 hr. The inhibitory effect of Cu and Cd on the growth of S. obliquus at initial biomass concentrations of about 2 g/l dry wt is perceptible, and the algae apparently accelerate and increase the removal of copper and cadmium from the medium. (Rochester-IVI)
W86-00697

USE OF WATERSHED CHARACTERISTICS TO SELECT CONTROL STREAMS FOR ESTIMATING EFFECTS OF METAL MINING WASTES ON EXTENSIVELY DISTURBED STREAMS,

Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
R. M. Hughes.
Environmental Management, Vol. 9, No. 3, p 253-262, 1985. 4 Fig, 3 Tab, 35 Ref. EPA grant R806391.

Descriptors: *Mine wastes, *Water pollution effects, *Streams, *Controls, *Watersheds, Sediments, Heavy metals, Stream pollution, Trout, Riparian vegetation, Invertebrates, Habitats.

Impacts of sediments and heavy metals on the biota of streams in the copper-mining district of southwestern Montana were examined by comparing aquatic communities of impacted streams with those of control streams. Control streams were chosen through the use of a technique that identifies similar streams based on similarities in their watershed characteristics. Signficant differences between impacted and control sites existed for surface substrate, riparian vegetation, and the number of macroinvertebrate taxa. These results revealed that: (a) chemical and physical habitats at the impacted sites were disrupted, (b) the presence of trout was an inadequate measure of ecological integrity for these sites, and (c) watershed classification based on a combination of mapped terrestrial characteristics provided a reasonable method to select control sites where potential control sites upstream and downstream were unsuitable. (Author's abstract)
W86-00725

SEPARATING STARVATION LOSSES FROM OTHER EARLY FEEDING FRY MORTALITY IN STEELHEAD TROUT SALMO GAIRDNERI, CHINOOK SALMON ONCORHYNCHUS TSHAWYTSCHA, AND LAKE TROUT SALVELINUS NAMAYCUSH,

New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
J. C. Skea, J. Symula, and J. Miccoli.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 82-91, July, 1985. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Starvation, *Mortality, *Trout, *Salmon, *Fish hatcheries, *DDT, *Fish toxicants, Fish physiology, Growth, Syndrome, Aquaculture.

Calculating time of exposure in terms of temperature units (TU = temperature in degrees C x hours at temperature / 24) made it possible to show that death of fry due to starvation occurred at a significantly different time from death due to toxic (DDT) syndrome in steelhead trout, lake trout, and chinook salmon from various water bodies in New York and Lake Michigan. This DDT syndrome, a condition which has been observed since 1964 in some species, includes death of fry characterized by distended air bladder, air in the intestinal tract, and erratic swimming. When unfed fish were separated according to source female, and held without feeding, death from DDT syndrome occurred in a peak occurring within approx 300 TU from 50% swim-up, regardless of the length of time required to reach this stage of maturation. The losses were female-dependent in steelhead trout. Chinook salmon from Lake Ontario did not exhibit syndrome, but steelhead trout from this lake did. The peak of mortality from starvation came a few hundred TU after the peak associated with DDT syndrome, and the appearance of fish dying of syndrome was very different from that of those dying of starvation. DDT syndrome loss, which is female-dependent, may result from pesticides or nutritional deficiencies during oogenesis and/or vitellogenesis; mortality that occurs after this period can be correlated with poor fry diet or other cultural causes. Recognition of the temporal separation of DDT syndrome losses from diet effects has already resulted in significant savings in production costs in the New York State hatchery system. (Rochester-IVI)
W86-00728

NITRITE EXPOSURE AND RESPIRATION RATES IN FATHEAD MINNOWS,

North Texas State Univ., Denton. Dept. of Biological Sciences.
D. E. Watenpaugh, and T. L. Beitinger.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 106-111, July, 1985. 1 Tab, 26 Ref.

Descriptors: *Nitrites, *Respiration rates, *Minnows, *Toxicity, Water pollution effects, Fish, Hardness, Oxygen consumption, Fish physiology, Animal physiology.

Acute exposure of fathead minnows (Pimephales promelas) to nitrite reduced their weight-specific oxygen consumption by about 22%. Acute (24 hr) static exposures of fish to nitrite were conducted in aerated, reconstituted hard water at 19 + or - 1 C. Minnows used weighed 0.60 + or - 0.15 g, and nominal doses of 0, 9, 18, and 27 mg/l NO2-N were employed, with replications of 15-20 fish per replicate. Routine respirometry measurements were conducted with individual fish in 300 ml bottles closed for 90 min at 19.2 + or - 0.2 C. Some fish died during exposure to nitrite and during subsequent respirometry; both types of mortality were significantly correlated with nitrite level. Most fish were minimally active during respirometry; severely stressed fish were somewhat less active. Mean weights of minnows from the various nitrite concentrations were not significantly different. Although mean routine respiration rate of minnows at the lowest nitrite exposure were not significantly lower than that of the controls, the rates of the fish receiving the two highest nitrite exposures were significantly lower than the controls. Although routine respiration rate determinations detected a sublethal effect of nitrite, such determinations are usually insensitive indicators of changes in metabolic rate induced by chemicals, because activity is unregulated. Effects of chemicals on metabolic rate are better evaluated with standard or active weight-specific oxygen consumption when possible. (Rochester-IVI)
W86-00729

RESPONSES OF MACROBENTHOS COLONIZING ESTUARINE SEDIMENTS CONTAMINATED WITH DRILLING MUD CONTAINING DIESEL OIL,

Environmental Research Lab., Gulf Breeze, FL.
M. E. Tagatz, G. R. Plaia, and C. H. Deans.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 112-120, July, 1985. 2 Tab, 20 Ref.

Descriptors: *Macrobenthos, *Estuarine environment, *Sediments, *Drilling mud, *Fuel, Water pollution effects, Mollusks, Annelids, Chordata, Arthropoda, Barium sulfate, Lime, Species composition, Ecological effects.

Communities of macrobenthos forming in field-colonized boxes containing drilling mud contaminated with diesel oil differed significantly in terms of numbers of individuals, numbers of species, and phylogenetic composition from boxes containing clean sand. Acrylic plastic boxes (32 x 32 x 6 cm deep) were positioned flush with the natural bottom surface at 3 m depth in Santa Rosa Sound

(Florida). They were filled with clean sediment, sediment containing lime drilling mud with 3.98 mg/g wet weight diesel oil, or sediment containing barium sulfate. Colonization was permitted for 8 wk, and all animals retained on a 1-mm mesh sieve were counted. A total of 1,081 animals representing 63 species and 10 phyla were collected. Mollusca, Annelida, Chordata, and Arthropoda were the dominant phyla. Only 24 and 32 spp occurred in the 1:3 and 1:10 lime-mud:sediment mixtures, respectively, compared to 43 spp in the control. Mollusks, particularly gastropods, and annelids were significantly affected. Although individuals and species were fewer in barite mixtures than in the control, only the species effect for combined phyla in 1:3 barite:sediment was significant. For all phyla combined, both the number of individuals and number of species in 1:3 mud mixtures differed significantly from those in barite mixtures; a significant difference in number of species was detected between the 1:10 mud mixtures and 1:10 barite mixtures. Species diversity, species dominance, and dissimilarity indices changed markedly only in communities exposed to 1:3 mud mixtures. Relative abundance of individual species for all treatments differed little from the control, as reflected by low Bray-Curtis dissimilarity indices; however, communities in 1:3 mud were most dissimilar. Indices calculated comparing the control with 1:10 barite, 1:3 barite, 1:10 mud, and 1:3 mud were 0.17, 0.20, 0.20, and 0.31, respectively. Species number and density were more sensitive and reliable indicators of stress than the biological indices employed. (Rochester-IVI)
W86-00730

ACUTE AND CHRONIC TOXICITY OF TECHNICAL PICLORAM (4-AMINO-3,5,6-TRICHLOROPICOLINIC ACID) TO DAPHNIA MAGNA STRAUS,

Dow Chemical U.S.A., Midland, MI. Mamammalian and Environmental Toxicology.
F. M. Gersich, D. L. Hopkins, and D. P. Milazzo.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 1, p 121-126, July, 1985. 1 Tab, 8 Ref.

Descriptors: *Toxicity, *Picloram, *Herbicides, *Daphnia, Water pollution effects, Bioassays, Pesticides.

Acute (48 hr) and chronic (21 day) toxicity studies with the herbicide compound picloram (4-amino-3,5,6-trichloropicolinic acid) indicate a comparatively low toxicity for the cladoceran Daphnia magna Straus. In the acute test, groups of 10 neonates were exposed to 12.7, 20.5, 34.5, 57.0, and 94.4 mg/l picloram; in the chronic test, neonates were allowed to grow and reproduce in glass tubes in solutions of 7.6, 11.8, 18.1, 29.6, and 46.9 mg/l picloram. The calculated 48-hr LC50 value was 68.3 mg (63.0-75.0 = 95% confidence interval). The no kill and 100% kill levels were 34.5 and 94.4 mg/l, respectively. The maximum acceptable toxicant concentration (MATC: based on mean total young/adult) estimated from the chronic study results was between 11.8 and 18.1 mg/l; the geometric mean value was 14.6 mg/l. Mean dry weight/adult was not statistically analyzed, nor was it used to estimate the MATC. The control mean dry weight/adult was 600 micro-g; all picloram-treated daphnids had a mean dry weight/adult of 500 micro-g, except the highest concentration, 46.9 mg/l, for which the value was 300 micro-g. The survival in the chronic test was from 90%-100% for the control and all picloram concentrations up to 29.6 mg/l, but was 60% for the 46.9 mg/l treatment (statistically significant at the 0.05 level). (Rochester-IVI)
W86-00731

PERCENT MORTALITIES AND LC50 VALUES FOR SELECTED MICROCRUSTACEANS EXPOSED TO TREFLAN, CUTRINE-PLUS, AND MSMA HERBICIDES,

Southern Univ., Baton Rouge, LA. Dept. of Biological Sciences.
S. M. Naqvi, V. O. Davis, and R. M. Hawkins.
Bulletin of Environmental and Toxicology, Vol. 35, No. 1, p 127-132, July, 1985. 2 Tab, 11 Ref. Louisiana Board of Regents, Research and Development Program project B-17.

Descriptors: *Herbicides, *Crustaceans, *Trifluralin, *Cutrine-plus, *Monosodium methanearsonate, *Toxicity, Water pollution effects, Arsenicals, Pesticides, Cladocerans, Calanoidians, Cyclopods, Ostracods,.

Three herbicides, Treflan (trifluralin), Cutrine-plus, and monosodium methanearsonate (MSMA), were shown to be toxic to a mixture of freshwater zooplankton collected in Lake Kernan, Louisiana. Treflan was much more toxic than the other two substances. LC50 values for Treflan (ppm) were as follows: Cladocera, 0.06; Calanoida, 0.08; Cyclopoida, 0.05; and Ostracoda, 0.06. Comparable values for Cutrine-plus were 11.3 12.21, 12.4, and 12.5, respectively, at a CaCO3 hardness of 140 mg/l. For the same compound at 280 mg/l CaCO3 hardness, respective LC50 values were raised to 18.5, 12.6, 16.4, and 15.3 ppm. MSMA was least toxic, with 48-hr LC50 values of 39.3, 37.6, 96.3, and 98.2 ppm, respectively, for Cladocera, Calanoida, Cyclopoida, and Ostracoda. Forty-eight-hour LC99 values for all microcrustacean groups together were 1.3-1.9 ppm for Treflan, 28.4-37.7 ppm for Cutrine-plus in soft water, 40.4-80.5 ppm for Cutrine-plus in medium hard water, 33.4-129.1 ppm for Cutrine-plus in very hard water, and 133.9-781.2 ppm for MSMA. Microcrustaceans were identified only to generic level (Alonella sp., Cladocera; Diaptomus sp., Calanoida; Eucyclops sp., Cyclopoida; and Cypria sp., Ostracoda). (Rochester-IVI)
W86-00732

AQUATIC BIOASSAY OF 11 PESTICIDES USING LARVAE OF THE MOSQUITO, WYEOMYIA SMITHII (DIPTERA: CULICIDAE),

Air Force Occupational and Environmental Health Lab., Brooks AFB, TX.
For primary bibliographic entry see Field 5A.
W86-00733

ENVIRONMENTAL AND ECONOMIC DAMAGE CAUSED BY SEDIMENT FROM AGRICULTURAL NONPOINT SOURCES,

Tennessee Valley Authority, Knoxville. Environmental Quality Staff.
A. M. Duda.
Water Resources Bulletin, Vol. 21, No. 2, p 225-234, April, 1985. 3 Fig, 1 Tab, 56 Ref.

Descriptors: *Nonpoint pollution sources, *Sediments, *Water pollution effects, Water quality, Agriculture, Soil erosion, Economic aspects, Environmental effects.

Environmental and economic damages caused by agricultural nonpoint source inputs of sediment and associated pollutants are examined. Widespread water quality problems are identified in lakes, rivers, and estuaries in agricultural areas, and billions of dollars of onsite and offsite costs result from this eroded soil every year. Some water bodies have been irretrievably damaged, and expensive rehabilitation programs are needed to remedy in-place water pollution problems if Clean Water Act goals are to be achieved. Unless effective abatement and rehabilitation programs are established, billions of dollars of benefits to future generations will not be realized as more waters become irretrievably damaged, and billions more will continue to be spent by government to treat symptoms of these sediment-related problems. (Author's abstract)
W86-00784

GOLD-MINING EFFECTS ON STREAM HYDROLOGY AND WATER QUALITY, CIRCLE QUADRANGLE, ALASKA,

Alaska Univ., Fairbanks. Inst. of Water Resources.
For primary bibliographic entry see Field 4C.
W86-00785

GOLD-MINING EFFECTS ON HEAVY METALS IN STREAMS, CIRCLE QUADRANGLE, ALASKA,

Alaska Cooperative Fishery Research Unit, Fairbanks.
J. D. LaPerriere, S. M. Wagener, and D. M. Bjerklie.
Water Resources Bulletin, Vol. 21, No. 2, p 245-252, April, 1985. 1 Fig, 7 Tab, 9 Ref. EPA project 808340-01.

Descriptors: *Gold mining, *Heavy metals, *Stream pollution, *Circle Quadrangle, *Alaska, Placer mining, Mine wastes, Arsenic, Mercury, Lead, Zinc, Copper, Cadmium, Water pollution effects.

Placer gold mining, which extracts gold from buried or exposed alluvia, is often conducted on or near streams. Such mining has the potential to adversely affect water quality. Other heavy metals associated with the gold (such as arsenic, cadmium, lead, zinc, and copper) may be freed to enter streams. Mercury may also enter streams if miners are using it to recover fine particles of gold. These heavy metals are toxic and thus may be harmful to the aquatic life of the streams receiving effluent or runoff from placer mines. In 1982 two streams were sampled intensively - one heavily mined and one unmined - for total recoverable arsenic, mercury, lead, zinc, and copper. Only mercury was not significantly higher in concentration in the mined streams. In 1983 two stream pairs were sampled three times, and 10 other sites at least once, for total and dissolved arsenic, cadmium, mercury, lead, zinc, and copper. Mercury and cadmium were not significantly elevated in mined streams, but the concentrations of total arsenic, lead, zinc, and copper, and dissolved arsenic and zinc were significantly higher in streams below active placer mining sites, than in these that were not being mined or those that had never been mined. Additonally, total arsenic, lead, zinc, and copper and dissolved arsenic and copper became elevated after mining began in 1983 on a previously unmined stream. (Author's abstract)
W86-00786

DISTRIBUTION AND PERSISTENCE OF AMINOCARB IN STREAM WATER, SEDIMENT AND FISH AFTER APPLICATION OF THREE MATACIL FORMULATIONS,

Forest Pest Management Inst., Sault Sainte Marie (Ontario).
For primary bibliographic entry see Field 5B.
W86-00811

RELATIONSHIPS BETWEEN SURFACE SEDIMENT DIATOM ASSEMBLAGES AND LAKEWATER CHARACTERISTICS IN ADIRONDACK LAKES,

Indiana Univ. at Bloomington. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W86-00829

VIRAL POLLUTION OF THE MARINE ENVIRONMENT,

Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
For primary bibliographic entry see Field 5B.
W86-00851

ASBESTOS IN DRINKING WATER

Department of National Health and Welfare, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5B.
W86-00853

EFFECT OF ACID RAIN ON SOILS,

Iowa State Univ., Ames. Dept. of Agronomy.
M. A. Tabatabai.
CRC Critical Reviews in Environmental Control, Vol. 15, No. 1, p 65-110. 8 Fig, 11 Tab, 166 Ref.

Descriptors: *Acid rain, *Soil chemistry, *Water pollution effects, *Acidity, Source of pollutants, Nutrients, Nitrogen, Sulfur, Ammonium, Fertilizers.

Soil reaction and pH, factors affecting soil formation, sources and forms of acidity in soils, the effect

mately leads to the death of the organisms. (Moore-IVI)
W86-00882

INFLUENCE OF DEVELOPMENT OF THE RIVER WIDAWKA ON THE EPHEMEROPTERA FAUNA (INFLUENCE DES AMENAGEMENTS DE LA RIVIERE WIDAWKA SUR LA FAUNE DES EPHEMEROPTERES),

Lodz Univ. (Poland). Inst. of Environmental Biology.
T. Jazdzewska.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, Part 4, p 2063-68, March 1985. 3 Fig, 1 Tab, 14 Ref,

Descriptors: *Aquatic insects, *Mayflies, *Environmental effects, *Widawka, *Poland, Mining, Stream stabilization, Temperature effects, Stream flow, Linings, Species diversity, Substrates.

The discovery of lignite deposits in Central Poland led to the foundation of the Belchatow Industrial Center (BIC). The construction of a deep shaft for mine drainage began in 1973, and in 1977 the removal of earth above the deposits commenced. The development of the BIC has led to unfavorable changes in the natural environment in the area, most of which lies within the Widawka river basin. The influence of the BIC on the Ephemeroptera of the Widawka was studied in segments of the river above and below the area of influence, and in an area where the river runs through a concrete bed. Changes in the flow and thermal regime of the river were observed after 1975. There was a notable decrease in the number of species after the introduction of the concrete bed; there were 23 species before and 9 species after the change in the bed. Modification to the substrate of the river exerts an influence on the fauna comparable to that of organic pollution. (Moore-IVI)
W86-00914

PATTERNS OF MACROINVERTEBRATE DISTRIBUTION IN THE LLOBREGAT RIVER BASIN (NE SPAIN),

Barcelona Univ. (Spain). Dept. de Ecologia.
For primary bibliographic entry see Field 2H.
W86-00917

5D. Waste Treatment Processes

EFFECT OF TEMPERATURE ON OXYGEN TRANSFER RATE IN WASTEWATER TREATMENT,

Cleveland State Univ., OH. Dept. of Civil Engineering.
Y. Dong, and Y.-T. Hung.
International Journal of Environmental Studies, Vol. 24, No. 2, p 125-135, 1985. 3 Fig, 7 Tab, 1 Ref.

Descriptors: *Wastewater treatment, *Oxygen transfer rate, *Temperature effects, Aeration, Industrial wastewaters, Domestic wastes, Organic compounds.

A comparison was made of percent error between empirical temperature coefficients and theoretical temperature coefficients. The applicable temperature ranges for empirical temperature coefficients were also discussed. In computing the oxygen transfer efficiency of surface aerators for wastewater, the combined effect of oxygen deficit and wastewater viscosity needs to be considered. The lower the wastewater temperature, the lower the oxygen transfer efficiency of surface aerators for wastewater, since viscosity has a dominating effect on oxygen transfer rate in wastewater at lower temperatures. It is recommended that the temperature, which is the average maximum temperature expected in the aeration tank mixed liquors, should be used in the calculation of oxygenation capacity and in the selection of surface aerators for wastewater treatment. (Baker-IVI)
W86-00658

CONTAMINANT DEGRADATION IN WATER,

North Carolina State Univ. at Raleigh. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5F.
W86-00660

NEW CONCEPTUAL FORMULATION FOR PREDICTING FILTER PERFORMANCE,

Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
V. Tare, and C. Venkobachar.
Environmental Science and Technology, Vol. 19, No. 6, p 497-499, June, 1985. 3 Fig, 8 Tab.

Descriptors: *Filtration, *Head loss, *Removal effficiency, Water treatment, Wastewater treatment, Filters, Unit Bed Element, Porous media, Mathematical equations.

This paper describes the development of a new conceptual model for predicting head loss buildup and removal efficiency during filtration by packed beds based on the postulate that some retained particles can act as collectors and thereby improve the filtration efficiency. The concept of Unit Bed Element (UBE) and of the unit collector is used for the quantitative description of the various processes of interest which occur in the porous medium. The filtration efficiency is described by a set of three interdependent equations for monosized particles in suspension assuming the porosity of the bed to remain constant as filtration progresses. The first equation computes the single collector removal efficiency related to clean grain efficiency and retained particles acting as collectors. The second equation estimates the number of retained particles acting as collectors as a function of depth, time, and local particle concentration in suspension. The third equation predicts suspended particle concentration with time over the entire filter depth. The head loss buildup is predicted by modifying the classical head loss equation for clean beds incorporating change in the surface area to volume ratio of the filter grains. The model is calibrated and verified with a set of laboratory data obtained from literature under varying conditions of operating and system variables. The results show strong agreement between model predictions and experimental observations as indicated by low values of standard error of estimate associated with coefficient of correlation values approaching unity. (Author's abstract)
W86-00661

REMOVAL OF ARSENIC FROM GEOTHERMAL FLUIDS BY ADSORPTIVE BUBBLE FLOTATION WITH COLLOIDAL FERRIC HYDROXIDE,

Hawaii Inst. of Geophysics, Honolulu.
E. H. De Carlo, and D. M. Thomas.
Environmental Science and Technology, Vol. 19, No. 6, p 538-544, June, 1985. 7 Fig, 1 Tab, 30 Ref.
DOE contract DE-FG03-81ER10250M003.

Descriptors: *Arsenic compounds, *Adsorptive bubble flotation, *Geothermal fluids, Wastewater treatment, Geothermal power, Ferric hydroxide, Hawaii Geothermal Project.

A method is described for the separation of arsenic species from high ionic strength geothermal fluids produced by the Hawaii Geothermal Project well-A (HGP-A). The oxyanions of As(III) and As(V), which are present at a concentration level of 100 +/- 10 micro-g/L total arsenic, are concentrated by adsorbing colloid flotation (ACF) onto, or precipitate flotation with, colloidal ferric hydroxide, depending on the pH. The anionic surfactant sodium lauryl sulfate (SLS) and the cationic surfactant lauryl-ammonium chloride (LA) are used as collectors below and above the isoelectric point (IEP), respectively. Efficiency of recovery of the trivalent arsenic oxyanion is pH and method dependent whereas that of the pentavalent arsenic is independent of the flotation method employed. Quantitative removal of total arsenic in solution is achieved above pH 6.5 by coprecipitation with ferric hydroxide; LA is used as the collector, and the air flow rate is 17 +/- 3 mL/min. The zeta potentials of flocs are greatly affected by a variety of species in the geothermal fluids and the source of iron. (Author's abstract)
W86-00662

BINDING OF CADMIUM, COPPER, AND LEAD IONS BY MODIFIED CELLULOSIC MATERIALS,

Benin Univ., Benin City (Nigeria). Dept. of Chemistry.
F. E. Okieimen, D. E. Ogbeifun, G. N. Nwala, and C. A. Kumsah.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 6, p 866-870, June, 1985. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Copper chloride, *Cadmium sulfate, *Lead nitrate, *Groundnut, *Adsorption, *EDTA, *Wastewater treatment, Metals, Heavy metals, Cellulose, Water treatment.

Groundnut (Arachis hypogaea) husk modified by complexation with ethylene-diaminetetraacetic acid (EDTA) demonstrated enhanced capacity to bind Pb(NO3)2, CuCl2, and CdSO4 from aqueous solution, indicating a potential use for modified groundnut husks in removal of heavy metal ions from wastewaters. In studies with Cu(II) ions, it was shown that the percentage of metal ion adsorbed initially increased with contact time, but stabilized at about 20 min, regardless of concentration (range: 200-500 ppm). The percentage of ion removed decreased as concentration increased, ranging from over 70% at 200 ppm to about 30% at 500 ppm. The concentration amount of metal ion adsorbed per gram of groundnut husks, however, increased as initial concentration of metal ions increased. In flow-through column experiments, the amount of metal ions removed from solution was Pb(II) > Cu(II) > or = Cd(II). For example, a Pb(NO3)2 initial concentration of 500 mg/l was reduced to 186 mg/l by passage through the column, an initial CuCl2 of 500 mg/l was reduced to 202 mg/l, and an initial CdSO4 concentration of 500 mg/l was reduced to 322 mg/l/. Proportionally greater reductions were obtained for lower initial concentrations of all three salts. In the equilibrium experiments, the amount of metal ion adsorbed was lower when groundnuts without EDTA were used. (Rochester-IVI)
W86-00692

SIMULATED SOLUTE MOVEMENT IN WASTEWATER-PONDED SOIL,

Florida Univ., Gainesville. Dept. of Plant Pathology.
R. S. Mansell, P. J. McKenna, and M. E. Hall.
Soil Science Society of America Journal, Vol. 49, No. 3, p 541-546, May-June, 1985. 8 Fig, 14 Ref.

Descriptors: *Solute transport, *Wastewater renovation, *Ponding, *Simulation, Land disposal, Rapid infiltration, Sorption, Wastewater treatment, Phosphorus, Mathematical models.

A finite-difference numerical model was used to predict sorption and transport of P in a rapid infiltration land system for renovating urban wastewater. The soil was assumed to be water-saturated and two-dimensional steady flow was assumed to occur from a 2-m wide ponded recharge zone toward a subsurface collection drain located at a lateral distance of 3 m. The rectangular area of interest was bounded underneath by an impermeable layer at the 1-m depth and was limited to a lateral length of 5 m. Phosphorus sorption in the soil was assumed to occur as two consecutive kinetic reactions - rapid physical adsorption followed by slower chemisorption. Transient movement and sorption of P in the soil was predicted with the model for a step-function increase in P concentration in the applied wastewater. Results predicted by the model were used to construct plots of concentration isopleths of P in solution and sorbed phases in the soil. Sorption reactions removed P from the flowing solutions in the soil directly beneath the recharge area, resulting in a retardation of the concentration of P appearing in the drainage water. Simulated breakthrough curves for the concentration of a nonreactive solute in the drainage effluent compared well to those obtained with an approximate analytical

model from published literature. (Author's abstract)
W86-00699

ENCLOSED VESSEL COMPOSTING BEGINS AT CAPE MAY COUNTY,

Cape May County (NJ) Municipal Utilities Authority.
For primary bibliographic entry see Field 5E.
W86-00713

PROTECTING WATER QUALITY IN THE MIDWEST: IMPACT ON TIMBER HARVESTING COSTS,

Minnesota Univ., St. Paul. Dept. of Forest Resources.
P. V. Ellefson, and P. D. Miles.
Northern Journal of Applied Forestry, No. 2, p 57-61, June, 1985. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Forest management, *Water quality control, *Costs, Cutting management, Water bars, Broad-based dips, Buffer strips, Culverts, Skid trails, Landings, Roads.

Practices designed to perfect water quality from forested areas have very real economic consequences for timber harvesting. The magnitude of such impacts varies with the practice in question and the market and financial conditions faced by the timber harvester. Costs were evaluated for six forest practices designed to prevent degradation of water quality from 18 timber harvesting operations in the Midwest. The six practices are water bars, broad-based dips, buffer strips, culverts, skid trail and landing design, and seeding of roads and landings. Net revenue reductions ranged from 1.2% for redesigning landing and skid trail locations to 26.4% for meeting buffer strip requirements. Nine operations were profitable with application of all six practices. Excluding the four harvesting operations having less than zero net revenue using conventional practices, 14 of the sales have a positive net return when culverts are added and landings and skid trails are redesigned. Thirteen sales maintain a positive net return with the addition of such practices plus the installation of water bars. (Moore-IVI)
W86-00720

HEAVY METAL CONCENTRATIONS IN MUNICIPAL WASTEWATER TREATMENT PLANT SLUDGE,

O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 5B.
W86-00726

REMOVAL OF SOLUBLE SUBSTRATES IN FIXED FILMS,

Krouger (I.) A/S, Soeborg (Denmark).
J. la C. Jansen, and P. Harremoes.
Water Science and Technology, Vol. 17, No. 2/3, p 1-14, 1985. 12 Fig, 4 Tab, 29 Ref.

Descriptors: *Fixed film reactors, *Biological wastewater treatment, Substrates, Biofilms, Bacteria, Denitrification, Oxidation, Methanol, Acetic acid, Glucose, Mathematical equations, Diffusion, Kinetics, Oxygen.

Common to all types of fixed film reactors are the processes within the fixed film. The substrates may be brought to the surface of the bacterial layer in many different ways, but inside the biofilm the substrates have to be transported, in soluble form, to the bacteria where the reaction takes place, and the reaction products have to be transported out again. Experiments were performed with denitrification and with oxidation of methanol, acetic acid and glucose in a laboratory fixed film reactor to demonstrate the validity of equations for removal of soluble substrates. A basic concept involving diffusional resistance to the bulk removal rate of soluble substrates in fixed films was verified. The experiments confirm the predictions of the half order reaction model, taking diffusion of the substrates and zero order intrinsic reaction rate of the bacteria as the dominating processes in the film. The experiments enable calculation of the kinetic parameters: diffusion coefficients, intrinsic reaction rates and half order rate constants for nitrate, methanol, acetic acid, glucose and oxygen within fixed films. Oxygen may be limiting for the surface removal rate of aerobic degradation of organics in fixed films due to the low solubility of oxygen in water and due to diffusional resistance to the oxygen transportation in the film. (Moore-IVI)
W86-00734

INFLUENCE OF PARTICULATE ORGANICS ON THE REMOVAL OF DISSOLVED ORGANICS IN FIXED-FILM BIOLOGICAL REACTORS,

Lund Univ. (Sweden). Dept. of Environmental Engineering/
E. Sarner, and S. Marklund.
Water Science and Technology, Vol. 17, No. 2/3, p 15-26, 1985. 3 Fig, 2 Tab, 16 Ref.

Descriptors: *Fixed film reactors, *Particulate matter, *Organic matter, *Dissolved solids, Biological wastewater treatment, Biofilms, Adsorption, Temperature, Glucose, Starch, Sludge.

Very little is known about the interaction between dissolved and particulate organics in the fixed-film biological process used for wastewater purification, although this process has been used for many decades. The mechanisms for the removal of dissolved and particulate organics differ and it has been found that a large fraction of the organics in most wastewaters exists in particulate form. In these experiments, the influence of particulate organics on the removal of glucose was studied in laboratory-scale fixed-film reactors. The particles used were starch particles and particles obtained from digested sewage sludge. The result of the experiments showed that for high glucose concentrations and high temperatures the removal of glucose was reduced when particles were adsorbed on the biofilm surface. A dramatic reduction was observed when large amounts of particles were adsorbed. This effect has also been observed in a full-scale trickling filter plant and in pilot trickling filters. At low glucose concentrations and low temperatures, however, a slight increase in glucose removal was observed when organic particles were adsorbed on the biofilm surface. (Author's abstract)
W86-00735

EFFECT OF LOAD FLUCTUATIONS ON THE EFFLUENT CONCENTRATION PRODUCED BY FIXED-FILM REACTORS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann.
Water Science and Technology, Vol. 17, No. 2/3, p 45-52, 1985. 8 Tab, 16 Ref.

Descriptors: *Fixed film reactors, *Biological wastewater treatment, *Loading rate, Effluents, Kinetics, Wastewater treatment, Model studies.

Although time-varying loads to biological treatment processes are common, typical kinetic models are based on steady-state loads and conditions. This paper uses nonsteady-state kinetics to demonstrate the impact of load variations on the effluent concentration and load from fixed-bed biofilm reactors. The different responses for reactors having average loads that are high, intermediate, and low are compared. In most cases, time-varying input loading, in comparison with steady input loading, causes an increase in average effluent concentration; however, certain combinations of load variation and reactor type allow better performance than do steady-state loads. (Author's abstract)
W86-00736

EVALUATION OF TEMPERATURE EFFECTS ON TRICKLING FILTER PLANT PERFORMANCE,

Hebrew Univ., Jerusalem (Israel). School of Applied Science and Technology.
A. Adin, E. R. Baumann, and F. D. Warner.
Water Science and Technology, Vol. 17, No. 2/3, p 53-67, 1985. 9 Fig, 4 Tab, 11 Ref.

Descriptors: *Temperature effects, *Trickling filters, *Wastewater treatment, Sedimentation, Biological wastewater treatment, Oxidation, Physical properties, Statistical methods, Biochemical oxygen demand, Suspended solids.

Wastewater temperature has an effect on both sedimentation and secondary biological treatment processes. While trickling filters are mainly affected due to temperature influences on the rate at which biological oxidation occurs, the settling processes are affected mainly through the temperature influence on the physical characteristics of the wastewater. A mathematical-statistical method was developed to help evaluate the temperature effect on BOD and suspended solids residual ratio during and after a trickling filter plant treatment. Mathematical relationships were developed and brought to workable linear forms which are used for statistical examination by the F test method. The data is provided by regular measurements of wastewater quality in a full-scale treatment plant. While settling performance did not respond consistently to temperature changes, the secondary treatment and the overall plant performance provided good correlations with the correct representative temperatures. When a correlation of efficiency due to wastewater temperature has to be made, one should not automatically take the raw sewage temperature for this purpose, but instead select a temperature representative of the process. (Moore-IVI)
W86-00737

ROLE OF AN ANAEROBIC STAGE ON BIOLOGICAL PHOSPHORUS REMOVAL,

Kurita Water Industries Ltd., Yokohama (Japan). Kurita Cental Labs.
T. Fukase, M. Shibata, and Y. Miyaji.
Water Science and Technology, Vol. 17, No. 2/3, p 69-80, 1985. 7 Fig, 5 Tab, 8 Ref.

Descriptors: *Anaerobic digestion, *Phosphorus removal, *Activated sludge process, Biological wastewater treatment, Polyphosphates, Biochemical oxygen demand.

A detailed study was conducted on biological removal of phosphorus by an activated sludge process composed of an anaerobic stage followed by an aerobic stage in order to clarify the role of the anaerobic stage of the process. Two distinctive sludges, one contained approximately 10% phosphorus, most of which existed in the form of polyphosphates, and other contained 1.9% phosphorus, were obtained by changing BOD concentration of influent and hydraulic detention time of the process. Although the polyphosphate-containing sludge released phosphorus in proportion to the absorbed BOD at anaerobic conditions, the sludge which did not contain polyphosphates also absorbed an equal amount of BOD at the identical rate without any external sources of oxygen. Both sludges accumulated identical levels of poly-beta-hydroxybutyrate within the sludges as the BOD sources were absorbed. These results suggest that the polyphosphate-containing sludges have no advantage over the sludges with no polyphosphates when they uptake BOD in the anaerobic stage. (Author's abstract)
W86-00738

INFLUENCE OF EXTENDED ANAEROBIC RETENTION TIME ON THE PERFORMANCE OF PHOREDOX NUTRIENT REMOVAL PLANTS,

National Inst. for Water Research, Pretoria (South Africa).
A. Gerber, and C. T. Winter.
Water Science and Technology, Vol. 17, No. 2/3, p 81-92, 1985. 2 Fig, 6 Tab, 7 Ref.

Descriptors: *Nitrogen removal, *Phosphorus removal, *Anaerobic retention time, Wastewater treatment, Nitrification, Denitrification, Chemical oxygen demand, Sludge settleability.

Laboratory-scale studies on the performance of three-stage Phoredox nutrient removal systems under nominal anaerobic retention times varying from 6 to 24 h are described. Particular attention is

given to the effect of these extended periods of anaerobiosis on biological phosphate release and uptake, nitrification and denitrification. Increasing the retention time in the abovementioned range had no deleterious effect on nitrification, COD removal, sludge settleability and denitrification but resulted in significantly improved phosphate removals. Up to 15 m/l phosphate (as P) could be removed from settled wastewater at nominal anaerobic retention times of 12 h or more. (Author's abstract)
W86-00739

LOCATION OF PHOSPHORUS IN ACTIVATED SLUDGE AND FUNCTION OF INTRACELLULAR POLYPHOSPHATES IN BIOLOGICAL PHOSPHORUS REMOVAL PROCESS,

Tokyo Univ. (Japan). Dept. of Urban and Sanitary Engineering.
T. Mino, T. Kawakami, and T. Matsuo.
Water Science and Technology, Vol. 17, No. 2/3, p 93-106, 1985. 9 Fig, 11 Ref.

Descriptors: *Phosphorus removal, *Activated sludge process, *Polyphosphates, Biological wastewater treatment, Aerobic conditions, Anaerobic conditions, Microorganisms.

The STS method, a method for the fractionation of intracellular phosphorus, was introduced into the examination of the phosphorus location of activated sludges, and some basic aspects involved in the biological phosphorus removal process were investigated from biological points of view. Although both lowmolecular and highmolecular polyphosphates appeared in the sludges produced in the biological phosphorus removal process, the high phosphorus content of the sludges was caused mainly by the accumulation of lowmolecular polyphosphates and lowmolecular polyphosphates were principally responsible for the release and uptake of phosphorus. The turnover of phosphorus in lowmolecular and highmolecular polyphosphates was investigated by using P-32 labelled orthophosphate as a tracer. The phosphorus turnover in lowmolecular polyphosphates was not observed under both anaerobic and anerobic conditions, while the phosphorus turnover in highmolecular polyphosphates occurred under the aerobic conditions. It was indicated that lowmolecular polyphosphates function as the energy pool under the anaerobic conditions and that highmolecular polyphosphates function as the phosphorus source for the microbial growth. (Author's abstract)
W86-00740

PHOSPHORUS REMOVAL FROM WASTEWATER BY THE CRYSTALLIZATION METHOD,

Kurita Water Industries Ltd., Yokohama (Japan).
I. Joko.
Water Science and Technology, Vol. 17, No. 2/3, p 121-132, 1985. 13 Fig, 2 Tab, 12 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Crystallization method, Calcium phosphate, Hydrogen ion concentration, Pilot plants.

To develop a new process for phosphorus removal the calcium phosphate crystallization method has been investigated. The metastable zone of calcium phosphate precipitates which is defined by concentrations of phosphate and calcium ions and pH was determined by batch experiments. Phosphorus in wastewaters can be constantly reduced to a sufficiently low level at the metastable reaction zone under the presence of seed crystals. The crystallization method proved to be practicable as advanced technology for phosphorus removal from wastewater through column tests and 50 cu m/day pilot plant tests over 180 days with a sewage secondary effluent. (Author's abstract)
W86-00741

PHOSPHATE REMOVAL BY CRYSTALLIZATION IN A FLUIDIZED BED,

DHV Consulting Engineers, Amersfoort (Netherlands).
J. C. van Dijk, and H. Braakensiek.
Water Science and Technology, Vol. 17, No. 2/3, p 133-142, 1985. 3 Fig, 6 Tab, 7 Ref.

Descriptors: *Phosphorus removal, *Fluidized bed reactors, *Crystallization method, Calcium phosphate, Recycling, Wastewater treatment.

Conventional methods for the removal of phosphates from wastewater produce a substantial amount of chemical sludge. A new process is described for the removal of phosphate from effluent from sewage treatment plants based on crystallization of calcium phosphate in a fluidized bed. No sludge is produced, only a small quantity of waterfree pellets. The calcium phosphate pellets can be used in the phosphate industry, thus creating a simple and effective method of recycling phosphate. In 1984 a demonstration unit with a capacity of 270 cu m/d will be built. Cost calculations were prepared for a full-scale plant. (Moore-IVI)
W86-00742

BATCH ANAEROBIC METHANOGENSIS OF PHENOLIC COAL CONVERSION WASTEWATER,

Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Fedorak, and S. E. Hrudey.
Water Science and Technology, Vol. 17, No. 2/3, p 143-154, 1985. 5 Fig, 3 Tab, 15 Ref.

Descriptors: *Anaerobic digestion, *Methanogenesis, *Coal conversion wastewater, Phenols, Organic acids, Inhibitors, Wastewater treatment.

Batch experiments using the Hungate serum bottle technique were used to determine the anaerobic treatability of phenolic (7600 mg/l by 4-aminoantipyrine) wastewater from an H-coal conversion pilot plant. Methane production above controls was achieved at up to 6% V/V dilution. At these levels, inhibitory components in the wastewater retard but do not stop volatile organic acid (VOA) fermentation to methane. Ether-extracted wastewater was tested at up to 50% V/V cultures receiving 200 mg/l phenol and was found not to be inhibitory, suggesting that inhibitory components in the wastewater are ether-extractable. Finally, a 'reconstituted H-coal' which contained pure phenolic constituents added to ether-extracted H-coal exhibited batch methanogenesis above controls at H-coal dilutions up to 10% V/V. These findings indicate that the ether-extractable inhibitory substances are not one of the major phenolic compounds present in the H-coal wastewater. (Author's abstract)
W86-00743

THERMOPHILIC ANAEROBIC CONTACT DIGESTION OF PALM OIL MILL EFFLUENT,

Rubber Research Inst. of Malaya, Kuala Lumpur (Malaysia).
A. Ibrahim, B. G. Yeoh, S. C. Cheah, A. N. Ma, and S. Ahmad.
Water Scicnce and Technology, Vol. 17, No. 2/3, p 155-166, 1985. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Anaerobic contact digestion, *Palm oil mills, *Thermophilic digestion, Anaerobic digestion, Malaysia, Wastewater treatment, Scum, Malaysia.

The palm oil industry in Malaysia generates enormous quantities liquid waste with high organic load causing serious pollution problems. Anaerobic pretreatment is usually practised prior to aerobic breakdown, and most of the anaerobic digesters operate under mesophilic conditions. The inherently high temperature of the effluent suggested that the thermophilic digestion would bring about a much more effective system. Pilot plant studies indicate that the anaerobic contact digester may be used for the digestion of palm oil mill effluent. At a temperature of 45 C, the digester could be operated at a maximum organic load of about 3.11 kg BOD/cu m/day, giving a percentage reduction of around 94%. A higher loading of about 3.44 kg kg BOD/cu m/day was tolerable at the higher temperature of 50 C, but some limitations in reactor design did not favor operation at these high loading rates. One obvious modification which may require incorporation is a provision for some scum breaking mechanism at the digester surface. (Moore-IVI)
W86-00744

OXIDATION OF SULFIDE AND THIOSULFATE AND STORAGE OF SULFUR GRANULES IN THIOTHRIX FROM ACTIVATED SLUDGE,

Odense Univ. (Denmark). Biological Inst.
P. H. Nielson.
Water Science and Technology, Vol. 17, No. 2/3, p 167-181, 1985. 3 Fig, 3 Tab, 36 Ref.

Descriptors: *Thiothrix, *Sulfides, *Thiosulfates, *Sulfur, *Activated sludge process, Bulking sludge, Sulfur bacteria, Wastewater treatment.

Thiothrix from activated sludge is, in the presence of oxygen, able to oxidize sulfide and thiosulfate and store many clear sulfur granules at sulfide concentrations less than about 1 mM and thiosulfate concentrations of 0.1-20 mM. On this basis, a sulfur storage test for the identification of Thiothrix in activated sludge was developed. It is shown that the filamentous bacteria, Type 021N (commonly causing bulking in sewage plants), is able to store sulfur granules and thus is a Thiothrix. In enrichment cultures with thiosulfate typical Thiothrix rosettes and motile gonidia are developed, and the presence of a sheath is demonstrated. Filamental diameter varies between 0.8-2.4 microm, the youngest filaments being thinnest. Attempts to isolate Thiothrix have been unsuccessful, but Thiothrix filaments with only a few contaminants are able to grow on solid media with acetate as the only carbon and energy source, indicating the presence of heterotrophic strains. The filamentous organisms of 14 Danish sewage treatment plants are identified, Thiothrix being the most common in 8, and responsible for bulking in 4 plants. (Author's abstract)
W86-00745

KINETIC STUDIES OF THE MICROBIOLOGICAL CONVERSION OF SULPHATE TO HYDROGEN SULPHIDE AND THEIR RELEVANCE TO SULPHIDE GENERATION WITHIN SEWERS,

Monash Univ., Clayton (Australia). Dept. of Chemical Engineering.
G. A. Holder, G. Vaughan, and W. Drew.
Water, Science and Technology, Vol. 17, No. 2/3, p 183-196, 1985. 7 Fig, 2 Tab, 17 Ref.

Descriptors: *Kinetics, *Sulfur bacteria, *Sewers, *Sulfides, Hydrogen sulfide, Mass transport, Mathematical equations, Model studies, Wastewater.

Corrosion of concrete sewers occurs as a result of hydrogen sulfide formation from sulfate-containing sewage. The problem arises because bacteria which utilize the sulfate ion as a source of oxygen flourish in warm anaerobic sewage. In order to design effectively form sulfide control, a reliable means of predicting the rate of sulfide production is desirable. Predictive equations presently in use are compared, and the desirability of replacing these empirical equations by a more scientific approach based on an analysis of mass transport and biochemical reaction is stressed. A theoretical analysis of mass transport and metabolism of sulfate during laminar flow in a model sewer is described. Laboratory experimental studies consisted of flowing simulated sewage through tubes containing biofilms of mixed cultures of sulfate reducing bacteria. The diffusional resistance in the liquid phase was negligible and the biological conversion of sulfate to sulfide followed zero order kinetics when mass transfer was not rate limiting. The observed sulfate removal rates gave good agreement with Australian field data for sulfide generation in sewers. The value of the zero order rate constant (measured at 41 C) was 30 mg/cu cm/h. The results of this study can be utilized to estimate potential hydrogen sulfide production in sewers. (Moore-IVI)
W86-00746

MIXING AND DETENTION TIME DISTRIBUTION IN ACTIVATED SLUDGE TANKS,

Hanover Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. Bode, and C. F. Seyfried.
Water, Science and Technology, Vol. 17, No. 2/3, p 197-208, 1985. 9 Fig, 14 Ref.

Descriptors: *Mixing, *Detention time, *Activated sludge process, Wastewater treatment, Tracers, Tanks, Plug flow, Aeration tanks, Particulate matter.

The manner in which wastewater is introduced into the tank and the mixing characteristics of the aeration tank are important parameters in the activated sludge process. Tracer test evaluation for activated sludge tank mixing is difficult due to the circulation of return sludge. The tracer response curves for tanks in plug flow and tanks in series approach the response curves of completely mixed tanks with increasing return sludge ratios. The return sludge cycle impedes the acquisition of definitive results considerably. The return sludge cycle produces invalid relevant concentration distribution for the aeration tank, due to delay of the return sludge in the secondary clarifyer and to multiple detection of tracer particles circulating in the return sludge cycle. Two methods for dealing with these difficulties are mentioned. One method applies to the case of tanks in parallel flow with common secondary clarification, the other applies to one line operation or several independent parallel lines. In the field, potentially existing stagnation zones in aeration tanks result in accelerated discharge of a portion of the influent as compared with stagnation-free tanks. This accelerated discharge is compensated for in the mean detention time by the delayed discharge of those particles found in the stagnation zones. Dead regions result, due to the lack of any liquid interchange whatsoever with the remaining tank contents, in an actual reduction of the mean detention time. The results from a field investigation of a tank with rotating flow demonstrate a clear difference between its tracer response curve and that for a completely mixed tank of equal size. (Moore-IVI)
W86-00747

INFLUENCE OF MACROMIXING ON ORGANIC CARBON UPTAKE AND SOLIDS PRODUCTION BY AEROBIC SUSPENDED BIOMASS,

Montpellier-2 Univ. (France). Lab. de Genie Chimique Applique aux Biotechnologies.
S. Elmaleh, T. L. Yoon, and A. Grasmick.
Water, Science and Technology, Vol. 17, No. 2/3, p 209-219, 1985. 9 Fig, 1 Tab, 15 Ref.

Descriptors: *Macromixing, *Organic carbon, *Aerobic digestion, *Aerobic suspended biomass, Mixing, Biological wastewater treatment, Kinetics, Solids production.

The influence of macromixing on organic carbon uptake by aerobic suspended biomass has been investigated using two reactors operated by parallel, i.e. a perfectly mixed reactor and a compartmented reactor. Conversion determined on filtrated samples is identical in both of the reactors but with less solids production in the low-dispersed reactor. The reaction rate established on the perfectly mixed reactor shows an apparent first-order with influence of inlet concentration but this relation cannot be used in a mass balance over the compartmented reactor. (Author's abstract)
W86-00748

EQUALIZATION CONTROL STRATEGY FOR ACTIVATED SLUDGE PROCESS CONTROL,

Cape Town Univ. (South Africa). Dept. of Chemical Engineering.
P. L. Dold, H. O. Buhr, and G. v. R. Marais.
Water, Science and Technology, Vol. 17, No. 2/3, p 221-234, 1985. 5 Fig, 7 Ref.

Descriptors: *Activated sludge process, *Process control, *Equalization control, Hydraulic load, Organic load, Automation, Microprocessors, Diurnal variation.

Fluctuations in hydraulic and organic loads cause wastewater treatment plant operating problems, necessitating some form of process control to ensure attainment of design objectives. A comparison of in-plant control with equalization control indicates that the latter is more appropriate for the case of long sludge age nutrient removal activated sludge processes which include anaerobic, anoxic and aerobic zones. A microprocessor-based control strategy is presented for the operation of an equalization tank upstream of the process to reduce, optimally, diurnal fluctuations in both flow and organic load rates. Results from implementation on a 150 Ml/d plant with an in-line equalization tank (4,5 hour mean retention time) demonstrate the successful performance of the control strategy. (Author's abstract)
W86-00749

A-B PROCESS: A NOVEL TWO STAGE WASTEWATER TREATMENT SYSTEM,

ESMIL International B.V., Amsterdam (Netherlands).
A. I. Versprille, B. Zuurveen, and T. Stein.
Water, Science and Technology, Vol. 17, No. 2/3, p 235-246, 1985. 7 Fig, 8 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *A-B process, Organic load, Hydrogen ion concentration, Toxic shocks, Two-step treatment, Sludge.

New acts on wastewater disposal demand for higher process stability and effluent quality. The A-B process, a novel two step treatment system, meets these requirements in a cost effective way. Five full-scale plants have been put in operation over the last two years. The objective of this paper is to give an outline of the features of the A-B system in the context of the results of these full-scale plants. In spite of the extreme high load, the A-stage can be operated at a higher reduction rate and is stable. Variations in the organic load and pH- and toxic shocks are leveled out and a constant, mainly soluble effluent is supplied. This implicates a low sludge production in the B-state. As a consequence higher overall reduction rates are obtained as compared to conventional processes at the same sludge load. Very low and stable final effluent concentrations are observed in all full-scale plants. Of special interest are the possibilities of upgrading existing conventional treatment facilities, at minor costs, by incorporating the A-B technology. The A-B process therefore can be considered as a very promising, cost effective alternative for both existing and new wastewater treatment plants in responding to the increasing effluent demands. (Author's abstract)
W86-00750

FLEXIBLE MODELLING OF THE ACTIVATED SLUDGE SYSTEM - THEORETICAL AND PRACTICAL ASPECTS,

Environmental Protection Service, Jerusalem (Israel).
M. S. Sheffer, M. Hiraoka, and K. Tsumura.
Water, Science and Technology, Vol 17, No. 2/3, p 247-258, 1985. 10 Fig, 10 Ref.

Descriptors: *Flexible modelling, *Activated sludge process, Computer models, Algorithms, Wastewater treatment, Model studies, Mixed liquor solids.

For the purpose of optimal modelling, a 'Flexible Modelling' method was developed. A flexible set of models consisting of hierarchical mechanistic models derived from a highly detailed structured model by mechanistic simplification was obtained. The performance of a computer program with an algorithm for parameter fitting in the time domain was evaluated by use of simulation. The program was able to estimate the models' parameters, even when using data with different degrees of inaccuracy. A computer program for model selection was developed, whereby the model was selected according to the information required. It was found that for prediction of the dynamic behavior of the MLSS, the simplest model can supply all the necessary information. For prediction of effluent substrate concentration, the differences between the models' predictions depend on the characteristics of the disturbances and on the values of the models' parameters. The selection of the proper model and updating its parameters can be done by a computer which uses the presented program for model selection and parameter fitting. (Author's abstract)
W86-00751

DETERMINATION OF KINETIC CONSTANTS OF ACTIVATED SLUDGE MICROORGANISMS,

Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. S. Cech, J. Chudoba, and P. Grau.
Water, Science and Technology, Vol. 17, No. 2/3, p 259-272, 1985. 9 Fig, 5 Tab, 11 Ref.

Descriptors: *Activated sludge process, *Kinetics, *Microorganisms, Respirometry, Biological wastewater treatment, Substrate removal.

A method for measuring kinetic constants of activated sludge microorganisms by means of a simple respirometer was developed and tested by using two types of mixed culture. The method can be used for those substrates that cannot be easily determined analytically. It is much more sensitive than the methods based on the biomass growth or substrates removal. The method determines kinetic constants of mixed cultures at given loading and mean cell residence time without changing its qualitative and quantitative composition. Both the maximum substrate removal rate and the half-velocity coefficient are basically lower with the mixed cultures cultivated in a completely-mixed reactor (filamentous) than with those cultivated in a selector-type reactor (nonfilamentous). (Moore-IVI)
W86-00752

DEVELOPMENT OF POLLUTANT SPECIFIC MODELS FOR TOXIC ORGANIC COMPOUNDS IN THE ACTIVATED SLUDGE PROCESS,

Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. T. Watkin, and W. W. Eckenfelder, Jr.
Water, Science and Technology, Vol. 17, No. 2/3, p 279-289, 1985. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Organic compounds, *Activated sludge process, *Model studies, Biological wastewater treatment, Phenol, Dichlorophenol, Dinitrophenol, Dinitrobenzene, Carbon tetrachloride, Volatilization, Biodegradation, Mathematical models.

The concept of pollutant specific models in completely mixed biological recycle reactors is developed. Pollutant specific Monod constants are developed by considering substrate utilization, cell growth, and endogenous decay rates based solely on influent and effluent specific pollutant concentrations. In this way, models are developed which predict specific pollutant removal in biological reactors. Three nonvolatile compounds are evaluated; namely, phenol, 2,4-dichlorophenol, and 2,4-dinitrophenol and their respective specific Monod constants determined. A pollutant specific model for concurrent biodegradation and volatilization is also developed. A mathematical method for evaluating the pollutant specific Monod constants independent of volatilization kinetics is derived for the volatile compounds dinitrobenzene and carbon tetrachloride. Control strategies are discussed which emphasize the rate limiting pollutant cncept. Conclusions are drawn as to the applicability and limitations of pollutant specific models. (Author's abstract)
W86-00754

KINETIC ANALYSIS OF BOD AND NITROGEN REMOVAL IN AN OXIDATION DITCH,

Kyoto Univ. (Japan). Dept. of Sanitary Engineering.
Y. Terashima, and M. Ishikawa.
Water, Science and Technology, Vol. 17, No. 2/3, p 291-302, 1985. 12 Fig, 4 Tab, 7 Ref.

Descriptors: *Nitrogen removal, *Biochemical oxygen demand, *Oxidation ditch, *Kinetics, Model studies, Nitrification, Denitrification, Dissolved oxygen, Alkalinity, Computer models, Simulation.

The simultaneous removal of nitrogen as well as organic substances is one of the important characteristics of the oxidation ditch process. To describe this phenomena, synthetic kinetic models including the rates of BOD oxidation, nitrification, denitrification, DO and alkalinity changes, and sludge growth were proposed in this study. Rate equations for these mechanisms were mainly based on Monod type kinetics taking into account several limiting effects among these mechanisms. To develop the design procedure, these kinetic models were combined with the tank-in-series model having circulating and back flows. They were analyzed numerically for typical design and operating conditions. From these computer simulations, successful results to explain these complicated phenomena and several design and operating bases were obtained. (Author's abstract)
W86-00755

STEADY STATE MEASUREMENT OF OXYGENATION CAPACITY,

Amsterdam Public Works (Netherlands). Sewerage and Drainage Dept.
K. de Korte, and P. Smits.
Water, Science and Technology, Vol. 17, No. 2/3, p 303-311, 1985. 9 Fig, 1 Ref.

Descriptors: *Oxygenation capacity, *Steady state measurement, Activated sludge, Aeration, Oxygen saturation, Wastewater treatment.

Oxygenation capacity (OC) measurement by the non-steady state method (reaeration) in tapwater or in activated sludge is difficult and expensive. The steady state method for measuring OC using activated sludge is presented. OC measurement at steady state conditions with (endogenous) activated sludge is practicable for various aeration systems and results in values representative for the practical conditions during measurement. The alpha factor, which influences the oxygen transfer coefficient, depends on the waste characteristics and the type of aeration system. Because the waste characteristics change during treatment, the alpha factor is not constant. With increasing degree of treatment, the influence of the alpha factor decreases. The beta factor, which influence the oxygen saturation, depends on the dissolved solids. In most cases the oxygen saturation is hardly influenced and the oxygen saturation in activated sludge is practically the same as in pure water. Steady state OC measurement is easy to do, is not labor-intensive and consequently can be performed at low cost. The results are satisfactory for most purposes. (Moore-IVI)
W86-00756

REMOVAL OF IRON CYANIDE FROM GOLD MILL EFFLUENTS BY ION EXCHANGE,

Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
D. T. Vachon.
Water, Science and Technology, Vol. 17, No. 2/3, p 313-324, 1985. 6 Fig, 5 Tab, 8 Ref.

Descriptors: *Iron cyanide, *Gold mill wastes, *Ion exchange, Industrial wastewater, Cyanides, Iron compounds, Mine wastes, Resins, Regeneration.

Using a strongly basic anion exchanger (Rohm and Haas Amberlite IRA-958) laboratory ion exchange tests were conducted on the removal of iron cyanide from synthetic and actual gold mill effluents. Variables examined included the effects of pH, concentration and hydraulic loading of the feed on the resin exchange capacity and resin column utilization. The results showed ion exchange to be an effective method of removing iron cyanide to concentrations of less than 3 mg/L. Tests with synthetic gold mill effluents gave resin exchange capacities ranging from 13 to 34 mg CNFe/mL resin depending on the concentration of iron, copper and zinc cyanides in these solutions. When raw barren bleed was tested, an exchange capacity for the ferro/ferricyanides was determined to be about 6 to 8 mg CNFe/mL resin. For chlorinated barren bleed, a resin exchange capacity of 14 mg CNFe/mL resin was observed. A capacity of 19 mg CNFe/mL resin was achieved for tailings pond decant. Regeneration with 15% NaCl provided mixed results with recoveries ranging from 40 to 100% of the iron cyanide exchanged by the resin. Upon multiple exchange-regeneration cycles, the resin lost 25% of the exchange capacity for total cyanide during the first cycle. Subsequently, the loss in exchange capacity was approximately 1% per cycle. Pilot scale tests were considered essential prior to full scale system design. (Author's abstract)
W86-00757

TOTAL EFFLUENT TREATMENT AND RINSE WATER RECLAMATION IN A SEMICONDUCTOR DEVICE MANUFACTURING FACILITY,

C3 International, Minneapolis, MN.
P. S. Cartwright.
Water, Science and Technology, Vol. 17, No. 2/3, p 325-336, 1985. 2 Fig.

Descriptors: *Metal-finishing wastes, *Semiconductor industry, *Wastewater renovation, Water reuse, Wastewater treatment, Electroplating, Copper, Nickel, Ultrapure water, Industrial wastewater.

A manufacturer of semiconductor devices uses several electroplated coatings during the production process. After each plating bath, the devices are rinsed in ultrapure water. Three of the baths contain toxic heavy metals (copper and nickel). In order to minimize the volumetric discharge containing the metals as well as the costs of purifying large quantities of raw water, a complete reclamation and waste treatment system was installed. The system consists of the rinse water reclamation system, the make-up water system, the polishing system, and the waste treatment system. Over 90% of the rinse water is purified back to 18 megohm/cm quality of reuse, and the concentrated toxic chemicals are precipitated and disposed of as an insoluble sludge. Based on maximum rinse water flow of 72,000 gallons per day, the total operating cost is $251.41/day. (Moore-IVI)
W86-00758

DEVELOPMENT OF A NEW PROCESS FOR TREATING URANIUM MINING EFFLUENTS,

Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Huck, W. B. Anderson, and R. C. Andrews.
Water, Science and Technology, Vol. 17, No. 2/3, p 337-350, 1985. 3 Fig, 9 Tab, 7 Ref.

Descriptors: *Uranium mines, *Mine wastes, *Radium, *Coprecipitation, Wastewater treatment, Fluidized bed process, Barium sulfate, Radium sulfate, Radioactive wastes.

Decants from Canadian uranium mining tailings areas are treated to remove radium-226 prior to discharge into the environment. This paper describes the development of a new treatment process for these effluents. This new process differs from existing systems in that it involves the use of a fluidized bed to facilitate $(Ba,Ra)SO_4$ coprecipitation on a granular medium of high surface area. No solids separation step is required, as the granular material is free draining. The new process has been demonstrated to provide radium-226 removal efficiencies consistently exceeding 90% in contact times of about 20 seconds. These short times are in contrast to times on the order of days for conventional pond systems or hours for mechanical systems involving stirred tank precipitation reactors. (Author's abstract)
W86-00759

DYNAMICS OF NITRIFICATION IN A BIOLOGICAL FLUIDIZED BED REACTOR,

Toledo Univ., OH. Dept. of Civil Engineering.
S. W. Hermanowicz, and J. J. Ganczarczyk.
Water, Science and Technology, Vol. 17, No. 2/3, p 351-366, 1985. 5 Fig, 3 Tab, 37 Ref.

Descriptors: *Fluidized bed process, *Nitrification, Biological wastewater treatment, Mathematical models, Simulation, Substrate removal, Biomass, Microorganisms, Mass transfer, Biofilms, Kinetics.

Dynamics of nitrification in a biological fluidized bed reactor was investigated with numerical simulations and experimentally in a small scale reactor. A mathematical model was developed describing reactor dynamics, substrate removal and biomass development. Variable microbial activity was used as a quantitative representation of the state of the microorganisms. External and internal mass transfer limitations were considered in substrate removal modelling. The effects of biofilm growth on reactor hydrodynamics and on substrate removal kinetics were incorporated into the model. In the experimental part, the performance of the nitrifying fluidized bed was monitored as the influent concentration was varied following an irregular square wave pattern. The observed changes of the effluent concentration depended not only on actual conditions but also on the past history of the system. Further analysis was carried with the help of the developed model. The concept of variable microbial activity was instrumental in explanation of the microbial dynamics. Predictive capacities of the properly calibrated model were demonstrated. (Author's abstract)
W86-00760

MODELING, OPTIMIZATION AND DESIGN OF FLUIDIZED BEDS FOR BIOLOGICAL DENITRIFICATION,

Technische Hogeschool Delft (Netherlands). Lab. of Sanitary Engineering.
T. J. Nieuwstad.
Water, Science and Technology, Vol. 17, No. 2/3, p 367-383, 1985. 7 Fig, 3 Tab, 27 Ref.

Descriptors: *Fluidized bed process, *Denitrification, *Model studies, *Optimization, Mathematical models, Biological wastewater treatment, Nitrates, Nitrites, Kinetics, Particle size.

A mathematical model for fluidized bed denitrification has been derived, based on the fluidization theory and on zero order kinetics for biological nitrate reduction with nitrite as an intermediate product. Bed expansion, particle size, sludge concentration and nitrate and nitrite concentration can be calculated as a function of the height in the bed. Complete optimal conditions were not found using carrier materials of various specific gravities and with sizes above a radius of 0.2 mm, which was arbitrarily chosen as the smallest carrier particle. However, for each size and type of carrier material an optimal thickness of the biomass layer has been calculated for a standard type of wastewater at constant flow rate. For the kinetic and other constants used in this study, graphs are presented which can be used in the design of fluidized beds for denitrification. (Author's abstract)
W86-00761

MATHEMATICAL MODEL OF SIMULTANEOUS ORGANIC OXIDATION, NITRIFICATION, AND DENITRIFICATION IN ROTATING BIOLOGICAL CONTACTORS,

Miyazaki Univ. (Japan). Dept. of Civil Engineering.
Y. Watanabe, S. Masuda, K. Nishidome, and C. Wantawin.
Water, Science and Technology, Vol. 17, No. 2/3, p 385-397, 1985. 14 Fig, 4 Tab, 11 Ref.

Descriptors: *Mathematical models, *Oxidation, *Nitrification, *Denitrification, *Rotating biological contactors, Biological wastewater treatment, Simulation, Organic matter, Computer models.

Simultaneous organic oxidation and nitrification rates in the RBC (rotating biological contactor) are given using a mathematical equation. The equation was derived from a hypothesis stating that intrinsic oxygen uptake rate of the biofilm has a constant value at a fixed temperature, independent of the composition of the aerobic bacteria. Based on this hypothesis, empirical equations are proposed to describe the profile of intrinsic organic oxidation and nitrification rates. Computer simulation of the simultaneous organic oxidation and nitrification

was carried out to confirm the empirical equations. The mathematical model of the simultaneous nitrification and denitrification is discussed and was tested by computer simulation. (Author's abstract)
W86-00762

APPLICATION OF PREDENITRIFICATION NITRIFICATION TECHNOLOGY FOR TRACE CONTAMINANT CONTROL,

Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
H. Melcer, and S. G. Nutt.
Water, Science and Technology, Vol. 17, No. 2/3, p 399-408, 1985. 2 Fig, 5 Tab, 21 Ref.

Descriptors: *Predenitrification nitrification, *Wastewater treatment, Coke plant wastewater, Coal liquefaction wastewater, Industrial wastewater, Activated sludge process, Fluidized bed process, Trace compounds, Organic compounds.

Predenitrification nitrification (PDN) technology was applied in two stage anoxic-aerobic systems treating coke plant wastewaters and coal liquefaction process condensates. Both activated sludge and biological fluidized bed modes of operation were investigated for their potential to remove ammonia, phenol, thiocyanate, cyanide and a wide range of trace organic contaminants. It was demonstrated that during nitrification of these complex wastewaters, simultaneous removal of most of the conventional and trace organic contaminants was achieved. Specifically, of the base/neutral extractable organic compounds, only di-n-butyl phthalate was consistently found in treated effluent samples at greater than trace levels (0.01 mg/l). It appears that trace organic contaminant control in complex industrial wastewaters can be achieved by the application of PDN technology. (Author's abstract)
W86-00763

ELEVATED NITRITE OCCURRENCE IN BIOLOGICAL WASTEWATER TREATMENT SYSTEMS,

Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. E. Alleman.
Water, Science and Technology, Vol. 17, No. 2/3, p 409-419, 1985. 6 Fig, 43 Ref. NSF grant CME-6006856.

Descriptors: *Nitrites, *Biological wastewater treatment, Ammonium, Nitrification, Temperature effects, Carbon dioxide, Oxygen, Hydrogen ion concentration, Nitrates.

Although nitrite plays a critical intermediary role in nitrification, it is generally regarded as a nominal constituent of nitrified wastewater effluents. Bench-scale and full-scale nitrification systems have reportedly encountered elevated nitrite concentrations. Several concerns are generated by this circumstance, including: an increased chlorine demand, an increased effluent nitrogenous oxygen demand, potential nitrite toxicity, and possible nitrosamine formation. An overview is provided of seven conditions which could lead to elevated nitrite occurrence in biological nitrification systems. The seven conditions include: reduced temperatures; limiting O2 or CO2 presence; elevated pH; free ammonia presence; elevated solids wastage; acute process loadings; and cryptic nitrate reduction. (Moore-IVI)
W86-00764

SINGLE SLUDGE ANOXIC-AEROBIC SYSTEMS FOR BIOLOGICAL TREATMENT OF COKE PLANT WASTEWATERS,

Istituto di Ricerca sulle Acque, Rome (Italy).
M. Beccari, A. C. Di Pinto, R. Passino, R. Ramadori, and V. Tandoi.
Water, Science and Technology, Vol. 17, No. 2/3, p 421-432, 1985. 3 Fig, 6 Tab, 13 Ref.

Descriptors: *Biological wastewater treatment, *Coke plant wastewater, *Single sludge process, Aerobic digestion, Anaerobic digestion, Phenols, Ammonium, Design criteria, Costs.

A study on the biological treatment of coke plant liquid wastes, with high concentration of ammonium nitrogen and phenols, is presented. The anoxic-aerobic single sludge process is used, with the phenols as electron donors in the denitrification process; the inhibiting effect of toxic substances present in the wastewater is prevented by means of dilution. Tests were conducted in a laboratory scale plant to determine the minimum dilution ratio necessary to avoid inhibition and the parameters required for the designing of a full scale plant. Finally the basic design considerations of a wastewater treatment plant for a 1000 t/d coke plant are reported and capital and running costs are evaluated. (Author's abstract)
W86-00765

UV INACTIVATION OF PATHOGENIC AND INDICATOR MICROORGANISMS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. C. H. Chang, S. F. Ossoff, D. C. Lobe, M. H. Dorfman, and C. M. Dumais.
Applied and Environmental Microbiology, Vol. 49, No. 6, p 1361-1365, June, 1985. 4 Fig, 31 Ref. EPA grant R809593010.

Descriptors: *Ultraviolet radiation, *Disinfection, *Pathogens, *Bioindicators, Bacteria, Viruses, Protozoans, Coliforms, Microorganisms, Spores, Cysts, Wastewater treatment, Water treatment.

Survival was measured as a function of the dose of germicidal UV light for the bacteria Escherichia coli, Salmonella typhi, Shigella sonnei, Streptococcus faecalis, Staphylococcus aureus, and Bacillus subtilis spores, the enteric viruses poliovirus type 1 and simian rotavirus SA11, the cysts of the protozoan Acanthamoeba castellanii, as well as for total coliforms and standard plate count microorganisms from secondary effluent. The doses of UV light necessary for a 99.9% inactivation of the cultured vegetative bacteria, total coliforms, and standard plate count microorganisms were comparable. However, the viruses, the bacterial spores, and the amoebic cysts required about 3 to 4 times, 9 times, and 15 times, respectively, the dose required for E. coli. These ratios covered a narrower relative dose range than that previously reported for chlorine disinfection of E. coli, viruses, spores, and cysts. (Author's abstract)
W86-00774

METHANOGENESIS IN AN UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR AT PH 6 ON AN ACETATE-PROPIONATE MIXTURE,

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
E. ten Brummeler, L. W. Hulshoff Pol, J. Dolfing, G. Lettinga, and A. J. B. Zehnder.
Applied and Environmental Microbiology, Vol. 49, No. 6, p 1472-1477, June, 1985. 9 Fig, 2 Tab, 24 Ref.

Descriptors: *Methanogenesis, *Upflow anaerobic sludge blanket process, Anaerobic digestion, Biological wastewater treatment, Methanothrix, Methanosarcina, Sludge, Hydrogen ion concentration.

High-rate anaerobic digestion can be applied in upflow anaerobic sludge blanket reactors for the treatment of various wastewaters. In upflow anaerobic sludge blanket reactors, sludge retention time is increased by a natural immobilization mechanism (viz. the formation of granular type of sludge). When this sludge is cultivated on acid-containing wastewater, the granules mainly consist of an acetoclastic methanogen resembling Methanothrix soehngenii. This organism grows either in rods or in long filaments. Attempts to cultivate a stable sludge consisting predominantly of Methanosarcina sp. on an acetate-propionate mixture as substrate by lowering the pH from 7.5 during the start-up to approximately 6 failed. After 140 days of continuous operation of the reactor a filamentous organism resembling Methanothrix soehngenii prevailed in the sludge. The specific methanogenic activity of this sludge on acetate-propionate was optimal at pH 6.6 to 6.8 and 7.0 to 7.2, respectively. (Author's abstract)
W86-00776

SEWAGE EFFLUENT PUMPS,

Texas Agricultural Experiment Station, College Station.
B. L. Carlile.
Southwest and Texas Water Works Journal, Vol. 67, No. 2, p 10 and 12, May, 1985. 1 Fig.

Descriptors: *Low pressure pipe septic systems, *Pumps, *Septic tanks, Soil water, Wastewater irrigation, Mound waste systems, Wastewater disposal.

The low pressure pipe (LPP) septic system provides the greatest promise in home waste disposal because it has demonstrated a remarkable ability to work successfully in the marginal to poor soils that predominate in today's suburban developments. The LPP is a pressure-dosed soil absorption system composed of seven basic elements: (1) septic tank, (2) pumping tank, (3) submersible sewage effluent pump and controls, (4) high-water alarm, (5) supply line and manifold, (6) distribution network, and (7) suitable soil area. Effluent is forced uniformly through holes in a network of drill-perforated polyvinyl chloride pipe, with 1/8-1/4 inch holes spaced 3 to 8 ft apart. The greatest future for sewage effluent pump systems appears to be in small community and cluster housing systems, an application in which it has already gained some acceptance from the Environmental Protection Agency and lending institutions. Other applications of sewage effluent pumps are found in mound waste systems and wastewater irrigation systems. (Rochester-IVI)
W86-00803

ANOMALIES ARISING FROM ARBITRARY MEASURES OF THE STRENGTH OF SEWAGE,

T. Stones.
Effluent and Water Treatment Journal, Vol. 25, No. 3, p 103-107, March, 1985. 8 Tab, 16 Ref.

Descriptors: *Wastewater, *Physicochemical characteristics, *Oxygen demand, Biochemical oxygen demand, Permanganate value, McGowan strength, Chemical oxygen demand, Nitrogenous oxygen demand, Total oxygen demand, Chemical characteristics, Effluent charges.

Characteristics of biochemical oxygen demand (BOD), permanganate value (PV), McGowan strength, chemical oxygen demand (COD), nitrogenous oxygen demand (NOD), and total oxygen demand (TOD) as measures of the strength of sewage were compared. Comparisons of BOD and PV of sewage with the COD have shown that the proportion of the total carbonaceous oxygen demand that they represent varies with the qualitative composition of the sewage. As a result, neither of these arbitrary parameters provides truly comparative measures of the total carbonaceous oxygen demand. They also fail to account for the NOD placed on a treatment plant or, in the case of highly nitrified effluents, the degree of nitrogenous oxidation that has been effected during treatment. Use of these arbitrary measures of sewage strength causes problems in plant management and in proper assessment of trade effluent charges. The BOD and PV measures give results that, in trade effluent charge situations, would cause the industry to be undercharged for treatment if BOD were used, and overcharged if PV were used. The ratio of BOD to COD does, however, give a rational indication of the amenability of sewage to treatment. TOD affords a valid overall criterion for realistic assessment of the capacity and performance of sewage treatment plants, and it provides a means of differentiating between the changes that have been effected in the carbonaceous and nitrogenous oxygen demands during treatment. TOD provides an equitable basis for levying trade effluent charges. (Rochester-IVI)
W86-00814

LUMPED-PARAMETER MODELING OF MULTICOMPONENT ADSORPTION IN THE TREATMENT OF COAL-CONVERSION WASTEWATER BY GAC,

Michigan Univ., Ann Arbor.

D. D. Endicott, and W. J. Weber, Jr.
Environmental Progress, Vol. 4, No. 2, p 105-111, May, 1985. 11 Fig, 8 Tab, 10 Ref.

Descriptors: *Adsorption, *Granular activated carbon, *Coal-conversion wastewater, *Lumped parameter value, *Wastewater treatment, Industrial wastewater, Model studies, Phenols, Cresol, Nitrophenol, Chlorophenol, Total organic carbon.

Granular activated carbon (GAC) adsorption of synthetic, multicomponent coal conversion wastewater was modeled as a lumped parameter using a single component version of the two resistance model (MADAM: Michigan Adsorption Design and Applications Model). The predictive ability of this system was quite good. Synthetic coal conversion wastewaters consisted of different concentrations of phenol, p-cresol, o-nitrophenol, and p-chlorophenol; total organic carbon, the lumped parameter measure, was 932 mg/l in 3 solutions, 646 mg/l in the other two. Values of the standard deviation between model prediction and independent GAC column verification ranged from 3.2 to 17%. Completely mixed batch reactor isotherm and short bed adsorber (SBA) experiments produced adequate adsorption parameters for lumped parameter modeling. The values of the film transfer coefficient obtained by the SBA technique were significantly smaller than those calculated by a correlation procedure. The values of intraparticle surface diffusion coefficient were fairly consistent with reported values of this coefficient for the primary wastewater component phenol. Verification of the model predictions with deep bed adsorber breakthrough data confirmed the validity of the modeling technique for this system. Isotherm parameters had a large influence upon the accuracy of model predictions The categorization of wastewater solutions based on multicomponent diversity aided in the selection of optimal isotherm parameters for a given DBA prediction. The accuracy of MADAM in modeling the adsorption of synthetic coal conversion wastewater appears sufficient to warrant its use for preliminary design of GAC treatment systems for this application. (Rochester-IVI)
W86-00815

REMOVAL OF PHOSPHATE AT SEWAGE TREATMENT WORKS AND IMPLICATIONS ON PHOSPHATE LOADINGS INTO LOUGH NEAGH,

Department of Economic Development, Lisburn (Northern Ireland). Water Quality Branch.
A. V. Gray.
Journal of the Institution of Water Engineers and Scientists, Vol. 39, No. 2, p 137-154, April, 1985. 14 Fig, 3 Tab, 13 Ref.

Descriptors: *Phosphorus removal, *Wastewater treatment, *Lough Neagh, *Ireland, Ferrric aluminum sulfate, Phosphorus loading, Algal growth, Costs.

Installation of ferric aluminum sulfate (FAS) liquor dosing for phosphorus removal at 10 sewage treatment works (STW) around Lough Neagh (Northern Ireland) resulted in a reduction of annual phosphorus loading from the STWs from 118 tonnes to 22 tonnes, a change which is estimated to significantly reduce algal growth in the Lough within 5-6 yr. The FAS coagulant was produced by mixing sulfuric acid with ferruginous bauxite mined locally. Laboratory evaluation of the FAS coagulation method showed when good phosphorus removals were achieved, there were correspondingly small metal residuals, suggesting no potential for a metal build-up problem. In addition, biochemical oxygen demand (BOD) reductions were increased by FAS dosing. At the Bullays Hill STW, a trickling filter plant receiving variable strength sewage, an extra 31-40% BOD reduction was obtained in the primary stage due to FAS dosing, suggesting that the method might be an effective means of obtaining a better quality final effluent at less cost than extending the STW in the conventional manner. All plants were ultimately set up for FAS dosing, and successfully achieved the target level of less than 1 mg/l P in the effluent. Isolated instances of pulses of high-P waste disrupted some operations, however. The daily FAS requirement for one plant receiving 10,900 cu m/day was 2,670 l, which at the time cost 92 pounds sterling. The overall volumetric increase in sludge as a result of the FAS dosing procedure was anticipated to be about 50%. (Rochester-IVI)
W86-00834

SURVEY TIES NEEDS TO WATER QUALITY,

A. B. Nichols.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 355-357, May, 1985. 2 Tab.

Descriptors: *Wastewater treatment, *Costs, *Water quality control, Population dynamics, Pollution load, Water pollution.

According to the 1984 U.S. Environmental Protection Agency (EPA) Needs Survey Report to Congress, $85 billion would be required to meet the wastewater treatment needs of the 1984 population of the United States and its territories, $101.7 billion to meet eligible year 2000 needs, and $108.9 billion to meet total (unrestricted) needs for the year 2000. Areas with relatively high needs for publicly owned wastewater treatment to the year 2000 include California (6,313 million), Florida ($4,533 million), Illinois ($1,204 million), Massachusetts (4,696 million), New Jersey ($4,684 million), New York ($15,184 million), Ohio ($ 4,834 million), Pennsylvania ($4,749 million), and Texas ($4,145 million). When 1984 needs are met, an estimated 32% more people (approximately 70 million) will receive treatment services, and pollutant load will drop 34%, resulting in improved water quality in streams throughout the country. The service population is estimated to increase by 55% by the year 2000 and the aggregate effluent load is estimated to increase 9%. The increase in pollutant removal capacity at municipal facilities probably will not keep pace with increased population growth. As a result, if year 2000 needs are met, water quality in the nation overall will remain about the same as today, but if the year 2000 needs are not met, severe water quality degradation will result. State planning has not been sufficient to fully address the impact of future pollutant loads resulting from bringing treatment services to more people. (Rochester-IVI)
W86-00838

INNOVATIVE WATER MANAGEMENT PLAN REDUCES TREATMENT COSTS,

Culp/Wesner/Culp, Denver, CO.
B. R. Willey, and H. H. Benjes, Jr.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 378-383, May, 1985. 5 Fig, 5 Tab, 2 Ref.

Descriptors: *Wastewater treatment facilities, *Costs, Water management, Wastewater lagoons, Effluents, Ammonia, Water rights, Irrigation water, Trout streams, Water quality standards.

A four-cell lagoon system was designed and constructed to serve the town of Buffalo, Wyoming (population about 5,000). Reassessment of ammonia discharge criteria using a predictive model was the key to meeting stream criteria while resolving water rights issues and lowering charges. Discharge from the treatment plant to Clear Creek, a trout stream, occurs only from October through April of each year, with discharge into irrigation ditches during the rest of each year. Chlorination is employed only when discharging to irrigation ditches. The primary cells, which operate in parallel, are aerated to maximize treatment, prevent ice formation during winter, and minimize odors. All lagoons are lined with a bentonite-soil mixture to protect underlying groundwater. Gravity inflow to the primary cell eliminates the need for a raw wastewater pumping station, but pumping up through the polishing cells is required to conform to site topography. Implementation of this water management plan resulted in a present-worth saving of $4 million compared to an oxidation ditch system, the only acceptable conventional alternative in Wyoming. (Rochester-IVI)
W86-00841

USE OF A SWIRL CONCENTRATOR FOR COMBINED SEWER OVERFLOW MANAGEMENT,

Crawford, Murphy and Tilly, Inc., Springfield, IL.
G. Heinking, and N. Wilcoxon.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 398-402, May, 1985. 3 Fig, 1 Tab, 4 Ref.

Descriptors: *Combined sewer overflows, *Swirl concentrators, Wastewater treatment facilities, Suspended solids, Biochemical oxygen demand, Costs, Decatur, Illinois, Sangamon River.

Construction of combined sewer overflow (CSO) facilities that include a storage tank and swirl concentrator appears to be the most cost-effective solution to the CSO problem in Decatur, Illinois. Wide variations in biochemical oxygen demand and total suspended solids levels are to be expected from this system, however. Decatur is a city of more than 90,000 population that occasionally discharges CSO into the Sangamon River, which during summer months is nearly dry. To solve this problem various alternatives were considered, and a storage facility for 'first-flush' flow, plus a swirl concentrator to separate solids, was chosen as the most cost-effective solution and was approved by the Illinois Environmental Protection Agency. The swirl concentrator induces a swirl action in a liquid for solids separation, and is able to handle much higher flow rates for a given surface area and tank volume than conventional settling tanks. To reduce the size of the CSO facilities, an optimization study was conducted to ensure that intercepting sewer capacities were used effectively. The design for Decatur required five CSO plants. The plant at McKinley Ave., analyzed here in detail, was estimated to cost $1,273,800 in 1981; a plain settling-type CSO control facility was estimated at the same time to cost $2,273,700. Estimated annual operational costs for the two types of facilities were estimated at $156,540 and $231,800, respectively. (Rochester-IVI)
W86-00844

EFFECT OF AERATION, CADMIUM CONCENTRATION, AND SOLIDS CONTENT ON ACID EXTRACTION OF CADMIUM FROM A MUNICIPAL WASTEWATER SLUDGE,

Ohio State Univ., Columbus.
T. J. Logan, and R. E. Feltz.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 406-412, May, 1985. 6 Fig, 4 Tab, 13 Ref.

Descriptors: *Aeration, *Acid extraction, *Cadmium, *Sludge, Zinc, Nickel, Metals, Wastewater treatment.

Large amounts of Cd, Zn, and Ni, three trace elements of concern in land application of wastewater sludges, can be removed from anaerobically-digested wastewater sludges with extended aeration. Sludge from Kent, Ohio, was used for all experiments because of its relatively high Cd content (> 1,000 mg/kg); otherwise the sludge was typical of sludges in this part of the USA. Extended aeration (up to 14 days) necessary to oxidize inorganic and organic forms of Cd and convert the metal to acid-extractable forms. Aeration during the acid-extraction step was necessary to maintain Cd in an acid-extractable form and eliminated the need for additional extensive aeration prior to acid addition. Acid-extraction at pH 2 for 18 hr removed an average of 76% of the Cd. Cd acid extraction was positively correlated with Cd content in the original sludge and negatively correlated with sludge solids content. In addition, more than 70% of the Zn, Ni, Ca, and Mn were acid-extractable, and more than 25% of the Cu, Mg and K, 15% of the Fe, and less than 5% of the Pb, Cr, P, and Al were removed by the aerated acid-extraction procedure. (Rochester-IVI)
W86-00846

STRUCTURED MODELING OF THE ANAEROBIC DIGESTION OF BIOMASS PARTICULATES,

Eidgenoessische Anstalt fuer Wasserversorgung,

Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. D. Bryers.
Biotechnology and Bioengineering, Vol. 27, No. 15, p 638-649, May, 1985. 11 Fig, 3 Tab, 26 Ref, 1 Append.

Descriptors: *Structured modelling, *Anaerobic digestion, *Mathematical models, *Biomass, Model studies, Biodegradation, Biological treatment, Digestion, Sludge digestion, Chemical reactions.

Anaerobic digestion of biological organic particulates to methane was described by a structured mathematical model based on multiple-reaction stoichiometry, conventional material balances, and liquid phase equilibrium chemistry. A general stoichiometric treatment for any set of multiple biological reactions was derived based on a unit mass of oxygen equivalents of the reactions limiting substrate. The resultant model was calibrated to existing laboratory studies of mesophilic (35 C) acid phase and thermophilic (50-60 C) anaerobic digestion of waste-activated sludge. The model agrees well with two existing experimental studies of anaerobic digestion of biomass particulates. Hypothetical computer simulations illustrated possible instabilities of the anaerobic process under various operating scenarios. Digester pH dynamics are a complex interaction of liquid phase chemistry, gas transfer, and biological reaction. In this respect a structured model is capable of accounting for the various intermediates that exert direct influence on pH equilibrium while an unstructured model is not. (Collier-IVI)
W86-00848

BIOLOGICAL TREATMENT OF LANDFILL LEACHATES,

Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
E. S. Venkataramani, R. C. Ahlert, and P. Corbo.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 4, p 333-376. 15 Fig, 12 Tab, 144 Ref.

Descriptors: *Biological treatment, *Wastewater treatment, *Landfills, *Leachates, Water analysis, Water treatment, Environmental impact, Activated sludge process, Anaerobic digestion.

Characteristics of sanitary and industrial landfill leachates are described, and problems of their correct characterization are reviewed. Microbial degradation of anthropogenic and recalcitrant compounds, including aromatic compounds, is also reviewed, and aerobic biostabilization, anaerobic biostabilization, and physical/chemical treatment of sanitary landfill leachate are described. Biological treatment of hazardous wastewater and industrial landfill leachates is discussed, and case studies of growth rate, respiration, fate of organic carbon, and other microbial responses, and of in situ and on-site biodegradation of industrial landfill leachates, are described. Biological processes are generally very cost effective; they have been employed successfully at full scale to a wide variety of industrial wastes. Environmental impacts associated with biological processes are usually limited. Biological treatment methods should be considered because disposal site leachate invariably contains large amounts of oxygen-demanding material. The activated sludge process, or a modification of it, appears to have the greatest potential for application to industrial leachate treatment. It can be controlled to a great extent, and lends itself to the development of an acclimated culture. Anaerobic digestion, because of minimal sludge production and high energy efficiency, merits consideration in some situations. Studies with sanitary landfill leachate treatment indicate that biological methods, such as activated sludge, anaerobic filtration, aerated lagoons, and combined treatment, are applicable for treating such leachate from new dump sites. Physical/chemical treatment methods, such as adsorption on activated carbon, chemical precipitation, chemical oxidation, and reverse osmosis, are best applied to biologically stabilized leachate. (Rochester-IVI)
W86-00856

BIOLOGICAL REMOVAL OF PHOSPHORUS FROM WASTEWATER,

Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
E. Arvin.
CRC Critical Reviews in Environmental Control, Vol. 15, No. 1, p 25-64. 13 Fig, 15 Tab, 102 Ref.

Descriptors: *Biological treatment, *Phosphorus removal, *Wastewater treatment, Water treatment, Nitrates, Anaerobic digestion, Sludge digestion.

Principles of the main treatment processes for removal of P from wastewater, the mechanism of biological P removal, chemical phosphate precipitation in biological P-removal systems, characterization of P fractions in sludge, factors in design of mainstream and sidestream treatment plants, and operational problems of these plants are reviewed. Sidestream processes are able to reduce P to a level of about 1 mg of P per liter under optimal conditions; mainstream processes, under optimal conditions, can reduce P to about 2 mg/l, which, with a small dosage of iron or aluminum salt, can be further reduced to 1 mg/l. Both sidestream and mainstream processes may require effluent filtration if the effluent P concentration must comply with stringent limits. This is due to the relatively high P content in the sludge, about 4% of P in sidestream process and 3.5-6% in mainstream processes. The extent of biological P removal from wastewater increases with increasing concentrations of soluble, readily biodegradable organics in the sewage. Nitrate and oxygen in the influent to the anaerobic reactor decrease biological P removal through oxidation of the soluble, readily biodegradable organic matter. The reactor design in biological P-removal plants is normally based on simple criteria like (aerobic) sludge age and detention times. Future design will most likely be based on process models that take into consideration the specific composition of the wastewater. New models emphasize the role of poly-P-accumulating bacteria. (Rochester-IVI)
W86-00857

DESTROYING PYROGENS IN WATER,

Electricity Council Research Centre, Capenhurst (England).
For primary bibliographic entry see Field 5F.
W86-00870

ACTIVATED BIOFILTER PROCESS FOR WASTEWATER TREATMENT,

Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan, R. C. Landine, E. L. Winchester, and G. P. Wasson.
Effluent and Water Treatment Journal, Vol. 25, No. 4, p 129-134, April, 1985. 1 Fig, 6 Tab, 15 Ref.

Descriptors: *Wastewater treatment, *Activated biofilters, *Trickling filters, *Activated sludge process, *Biofilters, Filters, Water treatment, Cold regions, Costs, Economic aspects, Secondary wastewater treatment.

The activated biofilter (ABF) process is a hybrid of attached (trickling filter) and suspended (activated sludge) growth systems. For most domestic wastes the biocell is typically designed at a biochemical oxygen demand (BOD) loading of 3.2 kg/cu m per day. The settleability of the mixed liquor obtained from the biocell tower is quite good, even under severe shock loading. Numerous pilot studies have been conducted by the manufacturer and a case study was conducted by the US Environmental Protection Agenvcy at Helena, Montana. ABF was evaluated along with other processes for employment at Millidgeville, Saint John, New Brunswick, Canada, where a capacity of 6,820 cu m/day was anticipated based on service to a population of 12,000. Total present value costs for the competing systems were as follows: modified activated sludge process, $6,647,000; ABF, $6,023,000; rotating biological contactor system, $5,990,000; and deep shaft process, $7,431,000 (base design) or $7,625,000 (optimal design). Based on the economic criteria, plus energy, site, operational, and other considerations, ABF was recommended for secondary treatment at Millidgeville. The ABF system confers operational stability inherent in a trickling-filter system. Employment of short-term aeration as part of the process improves reliability. Heat loss across the system is minimal, an advantage in cold-climate operation. (Rochester-IVI)
W86-00871

PERFORMANCE OF AN UPFLOW ANAEROBIC REACTOR COMBINING A SLUDGE BLANKET AND A FILTER TREATING SUGAR WASTE,

National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
S. R. Guiot, and L. van den Berg.
Biotechnology and Bioengineering, Vol. 27, No. 6, p 800-806, June, 1985. 12 Fig, 4 Tab, 11 Ref.

Descriptors: *Upflow blanket filters, *Anaerobic digestion, *Biomass, Upflow reactors, Wastewater treatment, Biological wastewater treatment, Industrial wastewater, Food processing industry, Sugars.

The loading capacities of an anaerobic wastewater treatment system are essentially dictated by the amount of active biomass that can be retained in the reactor, provided a sufficient contact between active biomass and waste organic can be assured. A new hybrid reactor, the upflow blanket filter (UBF), combines an open volume in the bottom two-thirds of the reactor for a sludge blanket and submerged plastic rings in the upper one-third of the reactor volume. This UBF reactor was operated at 27 C at loading rates varying from 5 to 51 g COD/L d with soluble sugar wastewater (2500 mg COD/L). Maximum removal rates of 34 g COD/L d and CH4 production rates of 7 vol/vol d were obtained. The biomass activity was about 1.2 g COD/g volatile suspended solids per day. Conversion (based on effluent soluble COD) was over 93% with loading rates up to 26 g COD/L d. At higher loading rates conversion decreased rapidly. The packing was very efficient in retaining biomass. The filter at the top of the UBF reactor has two advantages: space occupied by packing is not lost space for active biomass; and exploiting the floating capacity of the plastic rings is an inexpensive method to enhance biomass accumulation. The system should be cheaper than an anaerobic filter (less packing) and more likely to avoid the problems of channeling and plugging usually occurring in the bottom part of an anaerobic filter. (Moore-IVI)
W86-00889

ANAEROBIC PRETREATMENT REDUCES MILL COSTS, IMPROVES EFFLUENT QUALITY,

Buhrmann-Tetterode N.V., Roermond (Netherlands). Wastewater Dept.
L. H. A. Habets, and J. H. Knelissen.
Pulp and Paper, Vol. 59, No. 4, p 66-69, April, 1985. 2 Fig, 2 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Pulp and paper industry, *Industrial wastewater, *Anaerobic digestion, Biogas, Costs, Water treatment.

The Upflow Anaerobic Sludge Blanket (UASB) reactor has proven to be efficient and cost effective with paper mill waste of high organic content in several different installations in the Netherlands. Pilot studies of the UASB process were conducted at various different scales, and full-scale reactors are now operating at Oude Pekala (2,472 cu ft volume), Roermond (35,300 cu ft volume), and Celtona (24,700 cu ft volume). The UASB process will function with either granular or non-granular sludge; granular sludge permits higher loadings without loss of sludge in the effluent. At the Roermond plant, where the USAB reactor pretreats wastewater to reduce the loading of an activated sludge (aerobic) plant, a daily loading of 0.99 lb chemical oxygen demand (COD)/cu ft/day has been achieved without problems. COD removal has stabilized at 75% or better, and biochemical oxygen demand (BOD) removal is almost 90%. The reactor also produces 4,590 cu ft/hr of biogas containing 1-3% H2S, which is used to generate steam used in paper production. Each ton of COD removal yields 4.7 tons of 150 psi steam; excess

biogas is flared. Each pound of COD converted yields 0.1 lb of new granular sludge, which can be used to start up new USAB reactors. After more than a year of operation, the Roermond anaerobic treatment plant has proven to be more cost-effective than aerobic digestion, mainly because the quantity of energy in the biogas produced exceeds the energy consumed to power the process. (Rochester-IVI)
W86-00890

ION EXCHANGE POTENTIALLY EFFECTIVE IN REDUCING EFFLUENT FROM BLEACH PLANT,

Jordan (Edward C.) Co., Inc., Portland, ME.
J. H. Fitch, Jr.
Pulp and Paper, Vol. 59, No. 4, p 132-135, April, 1985. 1 Fig, 3 Tab.

Descriptors: *Ion exchange, *Bleaching wastes, *Industrial wastewater, *Pulp and paper industry, *Wastewater treatment, Resins, Zinc, Copper, Cadmium, Nickel, Metals.

Batch and pilot scale ion exchange resin treatment plants at the bleach plant at Billerud Uddeholm (Skoghall, Sweden) effectively remove color, chemical oxygen demand, chlorinated phenols, chlorinated guaiacols, and complexed metals. The treatment plants, which use a special resin supplied by Diamond Shamrock Corporation, do not remove resin, fatty acids, and phthalates. Inorganic chloride was removed initially, but the removal rate declined after the cycle started. Zinc and copper are removed through complexation and chelation. Cadmium and nickel appear to be removed effectively in the second column but are virtually untouched in the first. Chlorinated phenols and guaicols are removed more efficiently toward the end of the treatment cycle, probably because of loss of ionic character at low pH and the subsequent interaction with compounds previously removed. Extended contact time yielded no benefits; effective removal was lost rapidly, and a considerable number of pollutants passed through the columns. Although the startup period was long and troublesome, a full-scale treatment plant has been operating for almost 4 yr with high availability and without any real problems. The resin life (estimated at 6 mo) is shorter than it should be, which has increased operating costs of the plant because chemical costs increase as the resin ages. (Rochester-IVI)
W86-00892

ANAEROBIC WASTEWATER TREATMENT SYSTEM OPERATES AT VERY LOW COST,

Tampella Oy A.B., Tampere (Finland).
S. Rekunen.
Pulp and Paper, Vol. 59, No. 5, p 122-125, May 1985. 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Pulp and paper industry, *Anaerobic digestion, *Industrial wastewater, Methane, Biogas, Operating costs, Costs, Activated sludge process.

The first stage of a methane-producing anaerobic reactor treatment system has begun operating at the Tampella paper mill at Anjala, Finland. This plant treats one third of the mill's total wastewater using reactors of 106,000 cu ft total volume; wastewater from the debarking plant, paper machines, and groundwood production is treated. The second stage of the plant will accomodate the rest of the total of 31 tons/day of biochemical oxygen demand (7-day) and 22 tons/day of suspended solids from the mill to achieve the regulatory goals of 6.6 tpd BOD and 8.8 tpd suspended solids. The process used was developed in the laboratory and in pilot studies conducted at the Anjala plant; it is named the TAMAN process. From the preclarifier, wastewater goes to the acid fermentation facility where micoorganisms break down organic matter to low-molecular-weight acids. In the acid stage, the homogenized wastewater is conducted to the methane stage, where bacteria break down the organic acids to methane and carbon dioxide. Some 4.8 cu ft of biogas is formed per pound of BOD reduction; it contains about 70% methane by volume. The pH of the wastewater is adjusted with Ca(OH)2 and nutrients such as urea and phosphoric acids can be added, if necessary. Sludge is collected in a separate tank from which it is conducted to a mechanical sludge processor. Sludge then can be burned in a fluidized bed boiler. Biogas is burned in a boiler or flared. For the Anjala site, the TAMAN process had construction costs similar to the activated sludge process, but the TAMAN process operating costs were only 10% of those for the same treatment capacity of activated sludge. In addition, the fuel value of the biogas is nearly $145,000 (US) per year. (Rochester-IVI)
W86-00893

5E. Ultimate Disposal Of Wastes

DISTRIBUTION OF ALUMINUM IN THE TISSUES OF THREE FISH SPECIES,

Northwestern State Univ. of Louisiana, Natchitoches. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W86-00621

SIMULATED SOLUTE MOVEMENT IN WASTEWATER-PONDED SOIL,

Florida Univ., Gainesville. Dept. of Plant Pathology.
For primary bibliographic entry see Field 5D.
W86-00699

ENCLOSED VESSEL COMPOSTING BEGINS AT CAPE MAY COUNTY,

Cape May County (NJ) Municipal Utilities Authority.
W. W. Cathcart.
BioCycle, Vol. 26, No. 4, p 24-27, May-June, 1985. 5 Fig, 3 Tab.

Descriptors: *Composting, *Cape May County, *New Jersey, *Enclosed vessel composting, Sludge utilization, Costs, Wastewater treatment.

The composting system for treatment of domestic sewage sludge in Cape May County, New Jersey is described. The ABV/Purac system of in/vessel composting can be described as a vertical plug flow process. The composting vessel is fed from above by a spreader conveyer with material to be composted, and the composted material is discharged from the bottom by a power screw conveyor. Air is supplied at the bottom of the reactor and exhausted at the top. A General Electric Series Six programmable control handles the process control elements of the system. Temperature, carbon dioxide, status of the conveying system, status of the aeration system, weight of the input material, weight of the transferred material, weight of the output compost, and various warning alarms are continuously monitored. The facility includes a sludge container building, amendment storage building, operations building, maintenance building, BIO reactor, blower room, CURE reactor, and compost storage building. The development and construction costs were $9.1 million (US) and annual operating costs are $575,000. Dewatered municipal sludge of minimum 20% total sludge solids and sludge cake density of 50-60 pounds/cu ft is the input; output is a medium coarse to fine, friable compost of 10 mm maximum organic particle size and 60% maximum moisture. Volatile solids are reduced a minimum of 40% by the facility, which processes 12.1 tons per day in summer (tourist season) and 2.2 tons/day (off-season) when operating continuously. It is anticipated that some operating costs will be offset by revenues generated from sale of finished compost and by user fees charged for disposal of sludge. (Rochester-IVI)
W86-00713

LAND APPLICATION SYSTEMS FOR MUNICIPAL SLUDGE,

Nolte (George S.) and Associates, Sacramento, CA.
R. W. Crites.
BioCycle, Vol. 26, No. 4, p 32-34, May-June, 1984. 5 Tab, 11 Ref.

Descriptors: *Land application, *Sludge disposal, *Fertilizers, Cadmium, Nitrogen, Metals, Nutrients, Agriculture.

For all sizes of municipal treatment plants, about 25% of the sludge produced is land applied. Advances in design techniques over the past 10 yr allow the benefits of land application to be realized with minimal adverse impact. Examples of municipal systems in the USA with different agricultural end uses for sludge are Modesto, California (on city parks, landfills and farmland), Manteca, California (for corn and ryegrass), Seattle, Washington (on forest land), and Salem, Oregon (fields producing grains, grasses and silage corn, and Christmas tree farms). The design approach for land application is based on the utilization of sludge as a replacement for commercial fertilizer. The annual application is usually based on either the nitrogen or phosphorus needs of a particular crop. The loading rate for cadmium addition is then checked against the nutrient-based loading rate, and the lower of the two rates is used for design. In calculating the nitrogen available to plants, account must be taken of the relatively low availability of the organic nitrogen in sludge. Once the cadmium and nitrogen loading rates have been compared, and the lower of the two chosen, the land area required to dispose of the sludge is calculated by the formula: $F = W/S$, where $F =$ field area, in acres, $W =$ sludge quantity, in tons/yr, and $S =$ the sludge loading rate, in tons/acre. Applying sludge to land provides considerable cost savings compared to incineration or landfilling. (Rochester-IVI)
W86-00714

SLUDGE MANAGEMENT: A RESEARCH UPDATE,

Weston (Roy F.), Inc., West Chester, PA.
Y. Hasit.
Biocycle, Vol. 26, No. 4, p 44-47, May-June, 1985. 80 Ref.

Descriptors: *Sludge, *Literature review, Research priorities, Polychlorinated biphenyls, Hexachlorocylohexane, Dieldrin, Heavy metals, Parasites, Stabilization, Composting, Sludge utilization.

A review of 1984 literature on sludge characteristics, solids concentration and conditioning, stabilization and inactivation, incineration, and ultimate disposal and utilization shows that most recent research has focused mainly on concerns and observations related to ultimate disposal of sludges, with few fundamental studies published on sludge properties, behavior and unit operations. Polychlorinated biphenyls, gamma-hexachlorocyclohexane, dieldrin, heavy metals, parasitic heleminth worms, and some mutagenic compounds have been reported from sludges. Sludge physical characteristics of importance to system design were examined in a few studies; centrifuges, filter presses, belt filters, and conditioning with polymers were among the topics studied. Stabilization and inactivation studies examined disinfection, pasteurization, lime stabilization, composting techniques, vermistabilization, and the occupational and public health aspects of composting. Operational problems of sludge incineration in Britain were attributed to variations in sludge quantity and quality, severe wear and tear due to inefficient grit removal, and equipment failures; in a Tennessee study, implementation of a fuel-efficient operating mode reduced annual fuel consumption by more than 40%. Land application of sludge has been studied recently from the points of view of heavy metal loading rates, effects of sludge on plant and animal life, the fate of organic pollutants and metals, accumulation of metals, and mined land reclamation. Other forms of sludge utilization studied were production of oil, fertilizer, energy, and bricks. (Rochester-IVI)
W86-00715

CONTROL OF METAL APPLICATION RATES FROM SEWAGE SLUDGE UTILIZATION IN AGRICULTURE,

Anglian Water Authority, Huntingdon (England). Directorate of Scientific Services.

For primary bibliographic entry see Field 5G.
W86-00854

PRIMARY/SECONDARY SLUDGE RECYCLED INTO VALUABLE AGRICULTURAL FERTILIZER,

M. J. Coleman.
Pulp and Paper, Vol. 59, No. 4. p 130-131, April, 1985. 1 Tab.

Descriptors: *Sludge disposal, *Fertilizer, *Land disposal, *Wisconsin, Agriculture, Vegetables, Nitrogen, Metals, Heavy metals, Cadmium, Zinc, Phosphorus, Potassium, Costs.

Consolidated Papers, of Wisconsin Rapids, Wisconsin, operates a program in which sludge from the company's Water Quality Center is distributed to local farmers for use on sandy, irrigated soils where a variety of vegetable crops (eg, green beans, potatoes, sweet corn, and beets) are grown. The paper mill yields about 270 wet tons/day of sludge, seven days a week; at present 2,000-3,000 acres are receiving sludge as a soil amendment. The application rate is 40-70 wet tons/acre, which translates into a nitrogen requirement of 100-200 lb/acre. The nitrogen content of the sludge is 1.8-2.5% on a dry solids basis; phosphorus as P (7.4 lb/dry ton) and potassium as K (3.6 lb/dry ton) in the sludge is low, but local soils are generally high in these elements in this part of Wisconsin. The sludge distribution program also includes monitoring of the receiving soils for nitrogen and solids, Cd, Zn, heavy metals, and priority pollutants, and monitoring local wells. Plants are tested for heavy metals and food quality. In spite of the costs associated with hauling the sludge, spreading it, and monitoring the effects, the program appears cost-effective when compared to landfilling and its associated siting problems and construction costs. Farmers receive fertilizer valued far above the nominal per acre cost charged by Consolidated Paper for its sludge. The program was introduced to farmers and the general public through a series of public meetings and agricultural show presentations. (Rochester-IVI)
W86-00891

5F. Water Treatment and Quality Alteration

EFFECT OF SULFITE DECHLORINATION ON THE ACCUMULATION OF WATERBORNE LEAD BY RAINBOW TROUT (SALMO GAIRDNERI),

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W86-00615

CONTAMINANT DEGRADATION IN WATER,

North Carolina State Univ. at Raleigh. Dept. of Chemical Engineering.
D. F. Ollis.
Environmental Science and Technology, Vol. 19, No 6, p 480-484, June, 1985. 6 Fig, 1 Tab, 32 Ref.

Descriptors: *Photocatalysis, *Water treatment, *Purification, Drinking water, Organic compounds, Photodegradation, Photochemical reactions, Halogenated hydrocarbons, Trichloroethylene, Perchloroethylene.

Heterogenous photocatalysis was examined as a possible tool for water purification. A slurry of 0.1 wt% TiO2 powder in water was continuously recirculated through a reactor, a temperature-controlled bath, and a vessel that held chloride (or bromide) ion and reference electrodes for monitoring the progress of the reaction. The sample was injected through the septum of an orifice of the vessel. This system was used to study the degradation of chloroethanes, chloroethylenes and bromoethylenes, chlorobenzene, and chloroacetic acids in dilute aqueous solutions. The common water contaminants, trichloroethylene and perchloroethylene appear to be the strongest candidates for degradation by a potential photocatalytic process. (Baker-IVI)
W86-00660

NEW CONCEPTUAL FORMULATION FOR PREDICTING FILTER PERFORMANCE,

Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-00661

REMOVAL OF ARSENIC FROM GEOTHERMAL FLUIDS BY ADSORPTIVE BUBBLE FLOTATION WITH COLLOIDAL FERRIC HYDROXIDE,

Hawaii Inst. of Geophysics, Honolulu.
For primary bibliographic entry see Field 5D.
W86-00662

DRINKING-WATER AND SANITATION PROJECTS: CRITERIA FOR RESOURCE ALLOCATION,

World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
R. C. Ballance, and R. A. Gunn.
WHO Chronicle, Vol. 38, No. 6, p 243-248, 1984. 2 Fig.

Descriptors: *Public health, *Developing countries, *Sanitation, *Drinking water, Water supply, Water quality, Bacteria, Protozoa, Viruses.

Most of the diseases associated with inadequate water supplies and sanitation in developing countries are caused by bacteria, protozoa, viruses or worms. The contamination of water by chemicals is a less common factor. The prevention of any infectious disease requires the transmission cycle to be interrupted. Water and sanitation related diseases may have either complex or alternative transmission cycles. In complex transmission cycles, a period of development occurs in one or two specific intermediate hosts before the pathogen becomes infective to humans. Health considerations in project appraisal which are considered include community heath status, existing water supply, proposed water supply, existing sanitation, proposed sanitation, community health programs and staff, community perception of needs, community population characteristics, community education facilities, project communication support, media for health education in the community, community organization and resources, community development projects, and a national support system. (Baker-IVI)
W86-00669

MUTAGENICITY ASSESSMENT OF DIFFERENT DRINKING WATER SUPPLIES BEFORE AND AFTER TREATMENTS,

Perugia Univ. (Italy). Cattedra di Igiene.
For primary bibliographic entry see Field 5A.
W86-00690

FACTORS INFLUENCING THE HIGH CONTENT OF BROMINATED TRIHALOMETHANES IN BARCELONA'S WATER SUPPLY (SPAIN),

Sociedad General de Aguas de Barcelona (Spain).
For primary bibliographic entry see Field 5B.
W86-00727

POTENTIAL USE OF ENZYMES FOR REMOVAL OF AROMATIC COMPOUNDS FROM WATER,

S. W. Maloney, J. Manem, J. Mallevialle, and F. Fiessinger.
Water, Science and Technology, Vol. 17, No. 2/3, p 273-278, 1985. 1 Fig, 2 Tab, 12 Ref.

Descriptors: *Water treatment, *Enzymes, *Aromatic compounds, Phenols, Chlorinated phenols, Peroxidase-peroxide system, Monochlorophenol, Dichlorophenol, Pentachlorophenol.

The removal of aromatic compounds by the peroxidase - hydrogen peroxide system was studied at low levels which might be encountered in surface waters which receive some industrial discharge. Three compounds, mono-, di-, and pentachlorophenol, are used as model aromatic compounds. The treatment process is characterized both in terms of specific compound removal and removal of its reaction products. The enzyme system is effective in eliminating chlorinated phenols at low levels from drinking water supplies, but does not remove their products from the water. Further work is necessary to determine if these by-products present a potential risk for the human health and if they are removed in other unit processes. The enzymatic procedure may offer an alternative to the standard treatments, for example for sporadic taste and odor problems associated with chlorinated phenols. (Moore-IVI)
W86-00753

UV INACTIVATION OF PATHOGENIC AND INDICATOR MICROORGANISMS,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5D.
W86-00774

ELIMINATION OF VIRUSES AND INDICATOR BACTERIA AT EACH STEP OF TREATMENT DURING PREPARATION OF DRINKING WATER AT SEVEN WATER TREATMENT PLANTS,

Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, M. Trudel, and R. Plante.
Applied and Environmental Microbiology, Vol. 49, No. 6, p 1418-1428, June, 1985. 6 Fig, 11 Tab, 25 Ref.

Descriptors: *Drinking water, *Water treatment, *Viruses, *Bacteria, Bioindicators, Disinfection, Enteroviruses, Raw water, Coliform, Chlorination, Sedimentation, Filtration, Ozonation.

Seven drinking water treatment plants were sampled twice a month for 12 months to evaluate the removal of indicator bacteria and cytopathogenic enteric viruses. Samples were obtained at each level of treatment: raw water, postchlorination, postsedimentation, postfiltration, postozonation, and finished (tap) water. Raw water quality was usually poor, with total coliform counts exceeding 105 to 106 CFU/liter and the average virus count in raw water of 3.3 most probable number of cytopathogenic units (MPNCU)/liter; several samples contained more than 100 MPNCU/liter. All plants distributed finished water that was essentially free of indicator bacteria as judged by analysis of 1 liter for total coliforms, fecal coliforms, fecal streptococci, coagulase-positive staphylococci, and Pseudomonas aeruginosa. The total plate counts at 20 and 35 C were also evaluated as a measure of the total microbial population and were usually very low. Viruses were detected in 7% (11 of 155) of the finished water samples (1,000 liters) at an average density of 0.0006 MPNCU/liter the highest virus density measured being 0.02 MPNCU/liter. The average cumulative virus reduction was 95.15% after sedimentation and 99.97% after filtration and did not significantly decrease after ozonation or final chlorination. The viruses isolated from treated waters were all enteroviruses: poliovirus types 1, 2, and 3, coxsackievirus types B3, B4, and B5 echovirus type 7, and untyped picornaviruses. (Author's abstract)
W86-00775

ASSESSMENT OF WATER UTILITY INFORMATION SYSTEMS AND THEIR USE OF COMPUTERS,

Cincinnati Univ., OH. Dept. of Mechanical and Industrial Engineering.
R. L. Shell, and N. A. Damachi.
Water Resources Bulletin, Vol. 21, No. 2, p 323-330, April, 1985. 1 Fig, 9 Tab, 9 Ref.

Descriptors: *Utilities, *Water conveyance, *Water treatment, *Computers, Ohio, Indiana, Kentucky, Recordkeeping, Maintenance, Inspection, Water storage, Water loss, Water metering.

A direct mail survey of all water utilities serving populations of 2,000 or more in the tri-state area - Ohio, Indiana, and Kentucky was conducted, and the following were determined: utility profile information, e.g., public/private ownership, age, number of accounts, etc.; an assessment of the degree of computerization presently in place to perform various functions; and an assessment of any plans that the utilities may have for future computerization. To analyze the data, an index of computerization was defined as the number of departments or major areas of each utility that presently have some computerization. Departments and major areas included: water pumping, treatment, storage and distribution; metering and billing; accounting and personnel records; inspection and maintenance; and utility operations. Discriminant analysis revealed strong significant differences between utilities that plan to use computers and those that do not. There is a rather limited use of computers in the tri-state area. Fifty-one percent of the water utilities in Kentucky do not use computers at all in their operations. In Ohio and Indiana the figures are 39% and 51%. Many utilities use computers only for billing. The major form of recordkeeping in water utilities in the tri-state area is manual. Water loss in many systems appears to be a problem in Kentucky. Enormous potential exists in small and medium sized utilities for computerization to improve operational efficiency. (Moore-IVI)
W86-00795

TRENDS IN DRINKING WATER TREATMENT THE SHAPE OF THINGS TO COME,

Metcalf and Eddy of New York, NY.
G. P. Fulton.
Public Works, Vol. 116, No. 6, p 80-83, 138 and 140, June, 1985.

Descriptors: *Drinking water, *Water treatment, *Future planning, Modernization, Filtration, Organics removal, Disinfection, Chlorination, Measuring instruments, Costs, Manpower.

Treatment systems of the future will be different from older systems as water purveyors use innovative techniques to achieve solutions to particular water quality problems at particular sites. Earlier designs employed a 'worst case' solution, which tended to introduce redundancy of equipment and high cost. Future systems will control intermittent quality problems (eg, giardiasis, viral epidemics, accidental waste spills, leaching from waste dumps, and pesticide contamination) with approaches designed for the conditions at a given locality. The preeminent changes likely to occur in surface water treatment for drinking should be in filtration, organics removal, and disinfection. Both operational and equipment innovations will be employed to improve filtration results. In the interim period before final regulations for organics are established, primary emphasis will probably be on multi-purpose measures that moderate potential organic contamination problems, including aeration or air stripping, air flotation, granulated organic carbon filter media, and ozonation. Accepted disinfection alternatives to conventional chlorination are chloramines, chlorine dioxide, and ozone. Monitoring and control systems are becoming more complicated, with greater reliance on computers for both data recording and operations; the greatest changes will occur in instrumentation. Staffs at treatment plants will become smaller, but more highly trained, as equipment becomes more sophisticated. Future plants wil be customized designs, each intended to cope with particular source water quality features. Use of multi-purpose unit process elements will be more common to both optimize performance and reduce treatment costs. (Rochester-IVI)
W86-00805

UTILITY BATTLES IRON AND MANGANESE,

Hibbing Public Utilities Commission, MN.
R. P. Richards, and S. N. Foellmi.
Public Works, Vol. 116, No. 6, p 91-95, June, 1985. 4 Fig, 1 Tab.

Descriptors: *Water treatment, *Drinking water, *Iron removal, *Manganese removal, *Hibbing, *Minnesota, Pilot plant studies, Water supply, Municipal water, Oxidation, Chlorine, Potassium permanganate.

Computer analysis and a pilot plant study were employed to develop an increased capacity and improved water quality in a supply system deriving all its water from wells. The water-supply system, located in Hibbing, in the heart of the northeastern Minnesota iron mining district, had a history of problems with high iron and manganese (exceeding Environmental Protection Agency (EPA) Secondary standards in flow from all its wells but one). In redesigning the system, four alternatives were examined in which water from the Scranton (high quality water) wells would be pumped to the distribution system, where it would be blended with effluent from a treatment plant that would process the water from the other wells. Chemical oxidation with chlorine and potassium permanganate and continuously regenerated manganese greensand pressure filters was shown through analysis to be the most cost-effective treatment process. A pilot plant test showed that this treatment method could reduce the iron and manganese contents below EPA limits; the pilot test also provided filter loading rate, filter run time, maximum head loss across the filter, and the chemical feed dosage data that were useful in designing the full-scale plant. The water treatment plant was placed on line in early 1984, and the flow rate has averaged 1.9 million gallons/day (mgd), with a peak production of 3.2 mgd. Finished water has consistently met all regulatory agency standards. The pilot plant work provided an excellent projection of the full-scale plant chemical treatment requirements. Treatment cost for iron and manganese removal (chlorine and potassium permanganate) has been about $24/million gallons. (Rochester-IVI)
W86-00807

CITY IMPLEMENTS TRIHALOMETHANE CONTROL PROGRAM,

Neel-Schaffer, Inc., Jackson, MS.
J. G. Sigman, and W. M. Ashley.
Public Works, Vol. 116, No. 6, p 98-99, June, 1985. 1 Fig, 2 Tab.

Descriptors: *Trihalomethanes, *Water treatment, *Jackson, *Mississippi, *Drinking water, Source of pollutants, Chlorination, Water pollution control, Filtration, Sedimentation.

The city of Jackson, Mississippi has successfully initiated an ammoniation program to bring trihalomethane (THM) levels down to meet National Interim Primary Drinking Water Regulations. In 1975, the total THM in water in Jackson was 334 ppb, primarily as a result of increasing urbanization along the banks of the Pearl River upstream from where the treatment plant withdraws source water. A variation to the usual chloramination design that was used here was carrying a free chlorine residual through part of the treatment process, which was done in response to the following local conditions: (1) onsite storage at the plant is limited, with only 6-10 hr between flash mixing and finished water pumping, (2) the Pearl River exhibits great fluctuations in bacterial quality, (3) the 28 rapid sand filters at the plant are exposed, and (4) it was decided to change the disinfection systems from pre- and post- chlorination to mid-point (after sedimentation and before filtration) chlorination and post (just prior to finished water pumping) ammoniation. Pre-start-up monitoring showed that in every quarterly sample from January 1981 through August 1983, the 100-ppb limitation for total THMs was exceeded, with an average typically around 200 ppb, but running to as high as 450 ppb. In the quarters since startup, there has been a 70% reduction in total THMs, with the average quarterly value at six sample points being around 84 ppb. Consumers report that as a result of elimination of the free chlorine residual the water tastes better. (Rochester-IVI)
W86-00808

REMOVING VOC FROM GROUNDWATER; PILOT, SCALE-UP, AND OPERATING EXPERIENCE,

CH2M Hill, Inc., Corvallis, OR.
W. D. Byers, and C. M. Morton.
Environmental Progress, Vol. 4, No. 2, p 112-118, May, 1985. 9 Fig, 4 Tab, 14 Ref.

Descriptors: *Volatile organic compounds, *Water treatment, *Tacoma, *Washington, *Groundwater contamination, *Air stripping, Tetrachloroethane, Dichloroethylene, Trichloroethylene, Perchloroethylene, Chlorinated hydrocarbons, Organic compounds.

A pilot study of packed tower air stripping, followed by observations on performance of a full-scale facility, demonstrated the viability and cost-effectiveness of this technique for removal of volatile organic compounds (VOCs) from well water. The initial analysis and subsequent pilot study were conducted in response to the discovery of up to 300 micro-g/l of 1,1,2,2-tetrachloroethane, 100 micro-g/l of trans-1,2-dichloroethylene, 130 micro-g/l of trichloroethylene, and 5 micro-g/l of perchloroethylene in well water in Tacoma, Washington. The pilot study was conducted in two series: air and water at ambient temperature (20 C) and with total VOC concentration in the influent of about 700 micro-g/l, and air and water chilled to 6 C, with a total VOC concentration of about 1,500 micro-g/l. The Onda method of predicting mass transfer coefficients for the scaled-up version of the plant was used because the present study and others had indicated good agreement between the Onda model and data taken on different types of packing, column sizes, and different compounds. The full-scale facility consisted of five towers, 12 ft in diameter, packed to a depth of 20 ft with 10-inch polyproplylene saddles. Water flow per tower was 700 gallons/minute; running in parallel the system could handle 3,500 gallons/minute. The towers have consistently removed 94-98% of the influent 1,1,2,2-tetrachloroethane, with an average 95.5% removal. Other compounds were essentially undetected in the effluent during normal operation, indicating overall VOC removal efficiencies in excess of 98%. The installed cost of the treatment system was approximately $750,000. (Rochester-IVI)
W86-00816

PACKED TOWER AERATION STRIPS TRICHLOROETHYLENE FROM GROUNDWATER,

Air Force Engineering and Services Center, Tyndall AFB, FL.
R. L. Gross, and S. G. TerMaath.
Environmental Progress, Vol. 4, No. 2, p 119-124, May, 1985. 10 Fig, 3 Tab, 15 Ref.

Descriptors: *Water treatment, *Groundwater contamination, *Air stripping, *Trichloroethylene, Chlorinated hydrocarbons, Granulated activated carbon, Operating costs, Capital costs, Aeration.

Laboratory determination of Henry's constant and mathematical estimation of appropriate parameters were used directly in the design of a full-scale packed tower air stripper using 16 mm Pall rings to remove trichloroethylene (50-8,000 micro-g/l) from water. The prototype packed tower system used two towers that could be operated either in series or in parallel. Performance generally exceeded design goals, with single tower removal rates of 86-98% and series operation removal rates of 96-99.9%. Higher volumetric air/water (G/L) ratio gave better removal up to a value of 18, with little improvement for G/L above that value. Treatment capacity for the prototype system is 4,540 liter/min in parallel or 2,270 liter/min in series. An unexpected bacterial growth occurred in the air strippers during the first few months of operation; it involved eight different, non-pathogenic organisms, and the accumulation was sufficient to increase head loss to a point where operations had to be stopped and the packing cleaned. Periodic calcium hypochlorite chlorination was insufficient to prevent recurrence of the growth, but continuous calcium hypochlorite chlorination was successful. Comparison of the air stripping tower system with granular activated carbon system previously used to treat the same waste stream showed that both capital and operating costs for the air stripping method were very much lower, with a treatment

cost per 1,000 liters of $0.26 versus $0.03, respectively. (Rochester-IVI)
W86-00817

REMOVAL OF NATURALLY OCCURRING COMPOUNDS BY COAGULATION AND SEDIMENTATION,

B. A. Dempsey.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 4, p 311-331. 10 Fig, 145 Ref.

Descriptors: *Water treatment, *Coagulation, *Sedimentation, *Aluminum, Chemical reactions, Double-layer compression, Charge neutralization, Adsorption, Heterocoagulation, Polyelectrolytes, Turbidity, Color.

Mechanisms for destabilization of contaminants during the process of coagulation, the chemistry of aluminum in water, and the removal of contaminants by coagulation, are reviewed including models of the coagulation process. The terms coagulation and flocculation have been used in the literature in ways that lead to semantic confusion. Destabilization of particles in coagulation can occur by at least four mechanisms: (1) double-layer compression, (2) charge neutralization, (3) formation of a sweep floc leading to adsorption or heterocoagulation of the contaminant, and (4) bridging by high molecular-weight polyelectrolytes. Conventional water treatment is oriented toward removal of turbidity (the most common surrogate parameter for particles) and sometimes color. Materials for which removal techniques have been developed include clays, microorganisms, asbestos, natural organic materials, inorganic solutes, and trace organic substances. Models of the coagulation process that apply to the techniques employed for coagulation of contaminants include particle numbers and size distributions, integral analysis of water plant performance, micromix theory, and models of coagulant reactions. (Rochester-IVI)
W86-00855

DESTROYING PYROGENS IN WATER,

Electricity Council Research Centre, Capenhurst (England).
R. Barker, S. Poole, and F. M. Taylor.
Effluent and Water Treatment Journal, Vol. 25, No. 4, p 119-124, April, 1985. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Pyrogens, *Water treatment, *Ozone, *Bacterial toxins, *Toxins, *Ultraviolet radiation, Escherichia, Shigella, Public health.

The UV/ozone method for removing pyrogens was tested using Escherichia coli endotoxin as the test pyrogen. An apparatus consisting of a flow-through ozonizer, followed by a 5-liter reaction vessel for exposure to UV (254 nanometer) light from a low-pressure mercury lamp, rendered dilute solutions of E. coli endotoxin pyrogen-free. Pyrogen presence or absence was determined by the Limulus amoebocyte lysate test. Both UV light and ozone were essential for the efficiency of the process. The rate of destruction of pyrogen was (1) only slightly dependent on the pyrogen concentration, (2) independent of the nominal concentration of ozone in the aqueous phase, above 1 ppm, and (3) increased as the UV irradiation intensity was increased. The presence of 0.9% w/v of sodium chloride in the solution did not affect the reactions taking place. In a typical experiment it took 30 min to reduce 100 nanogram (ng)/ml E. coli endotoxin to below the lysate sensitivity of 0.4 ng/ml. Solutions of 20, 40, and 200 ng/ml of Shigella dysenteriae were subjected to 1 hr of UV/ozone treatment, and all three passed the 'Test for Pyrogens' using rabbits. (Rochester-IVI)
W86-00870

OCCURRENCE OF CHLORINATED POLYNUCLEAR AROMATIC HYDROCARBONS IN TAP WATER,

National Inst. for Environmental Studies, Tsukuba (Japan). Div. of Chemistry and Physics.
For primary bibliographic entry see Field 5B.
W86-00895

5G. Water Quality Control

SECURITY OF GROUNDWATER CATCHMENTS NEAR RIVERS; CHARTS TO DETERMINE THE VARIATION IN THE REPLENISHMENT FLOW (SURETE DES CAPTAGES D'EAU SOUTERRAINE A PROXIMITE DES RIVIERES; ABAQUES POUR DETERMINER L'EVOLUTION DU DEBIT DE REALIMENTATION FLOW),

Laboratoire National d'Hydraulique, Chatou (France).
For primary bibliographic entry see Field 2F.
W86-00656

RE-EVALUATING THE EXTENT OF GROUNDWATER CONTAMINATION,

National Water Well Association, Worthington, OH.
J. H. Lehr.
Water and Pollution Control, Vol. 123, No. 3, p 16-18, May/June, 1985.

Descriptors: *Water management, *Groundwater supply, *Water supply development, *Groundwater pollution, Management, Decision making, Water resources development, Planning, Evaluating.

Through a series of assumptions, it is concluded that, even with groundwater pollution occurring, we have yet to pollute even 1% of the total groundwater supply. The initiation of new sources of groundwater pollution can be eliminated within the next 10 years which will put an end to ill conceived practices that brought about the problem in the first place. The existing contamination plumes will not have moved much further or polluted much more by then than they already have. The odds are that we will end up with 98% of the groundwater still unpolluted by the end of this century. Practices which have led to the path of wanton wastefulness are reviewed. The first course of action should be to implement some management options that will work. Also needed is an evaluation of where a lack of efficiency exists in using water and these practices should be eliminated. An evaluation of inefficient irrigation practices is one step. The conjunctive use of surface and groundwater can help reduce the impact of localized droughts. Perhaps one of the most neglected management options is that of artificial recharge. There is no loss to evaporation as with a surface reservoir and many sources of water, which normally flow out of the watershed, can be recycled and saved right there. (Baker-IVI)
W86-00686

PROTECTING WATER QUALITY IN THE MIDWEST: IMPACT ON TIMBER HARVESTING COSTS,

Minnesota Univ., St. Paul. Dept. of Forest Resources.
For primary bibliographic entry see Field 5D.
W86-00720

ENVIRONMENTAL AUDIT. II. APPLICATION TO STREAM NETWORK DESIGN,

Minnesota Univ., St. Paul. Dept. of Forest Resources.
For primary bibliographic entry see Field 7A.
W86-00723

STATUS OF NONPOINT SOURCE POLLUTION: ITS NATURE, EXTENT AND CONTROL,

Battelle Columbus Div., OH.
For primary bibliographic entry see Field 5B.
W86-00779

URBAN RUNOFF: POLLUTION SOURCES, CONTROL, AND TREATMENT,

Environmental Protection Agency, Edison, NJ. Storm and Combined Sewer Technology Branch.
R. Field.
Water Resources Bulletin, Vol. 21, No. 2, p 197-206, April, 1985. 2 Fig, 2 Tab, 101 Ref.

Descriptors: *Urban runoff, *Water pollution control, Storm wastewater, Water management, Land use, Drainage, Water storage, Wastewater treatment, Sewer systems, Water reuse, Water pollution sources.

This paper reviews progress on urban stormwater management and pollution control, with emphasis on non- and low-structurally intensive techniques along with the total system approach encompassing control-treatment. Many of the U.S. Environmental Protection Agency's demonstration-evaluation projects are presented to exemplify: Land Management Techniques, i.e., land use planning, best use of natural drainage, dual use of retention and drainage facilities required for flood control designed concurrently or retrofitted for pollution control, porous pavement, surface sanitation, and chemical use control; Collection Systems Control, i.e., catchbasin cleaning, flow regulators (including swirl and helical devices), and the new concepts of elimination or reduction of unauthorized cross-connections, in-channel/conduit storage and/or other forms of storage for bleed-back to existing treatment plants; Storage including in-receiving water storage; Treatment, i.e., physical/chemical, disinfection, and a treatment-control planning and design guidebook; Sludge and Solids Residue from Treatment; and Integrated Systems, i.e, storage/treatment, dual-use wet-weather flow/dry-weather flow facilities, and reuse of stormwater for nonpotable purposes. Recommendations for the future in the areas of: control based on receiving water impacts, toxics characterization and their control, sewer system cross-connections, integrated stormwater management, and institutional/sociological/economic conflicts are also presented. (Author's abstract)
W86-00781

FARMERS' ATTITUDES TOWARD NONPOINT POLLUTION CONTROL AND PARTICIPATION IN COST-SHARE PROGRAMS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
W. R. Kerns, and R. A. Kramer.
Water Resources Bulletin, Vol. 21, No. 2, p 207-215, April, 1985. 6 Tab, 14 Ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, *Attitudes, *Farms, *Cost sharing, Virginia, Loans, Taxes, Soil loss, Soil erosion, Public participation.

The success of government programs to control nonpoint source pollution depends upon attitudes toward those programs and the availability of technical and financial assistance. Applicants for the Rural Clean Water Program cost-share funding in Virginia possess different personal and operational characteristics than do nonapplicants. Factors associated with participation in the Rural Clean Water Program differed from those associated with the more traditional soil conservation programs. Discriminant analysis was used to differentiate between other farmers who may become applicants and nonapplicants. Farmers' attitudes toward various policy options for inducing implementation of nonpoint source management practices varied greatly. Farmers were most favorable to cost sharing, low-interest loans and tax credits, and least favorable to a soil loss tax. They were either very favorably or very unfavorably inclined toward cross-compliance between pollution control and other agricultural programs. (Author's abstract)
W86-00782

WATERSHED PLANNING FOR ACID MINE DRAINAGE ABATEMENT,

Georgia Univ., Athens. School of Environmental Design.
For primary bibliographic entry see Field 4D.
W86-00787

IN-LAKE WATER QUALITY MANAGEMENT PLAN FOR A RECREATIONAL LAKE IN CENTRAL ILLINOIS,

Illinois State Water Survey, Peoria. Water Quality Section.

R. K. Raman, and R. L. Evans.
Water Resources Bulletin, Vol. 21, No. 2, p 315-321, April, 1985. 2 Fig, 3 Tab, 10 Ref.

Descriptors: *Water quality management, *Lake restoration, *Johnson Sauk Trail Lake, *Illinois, Eutrophication, Destratification, Algal control, Copper sulfate, Potassium permanganate.

Johnson Sauk Trail Lake (Illinois) remains highly eutrophic, even though the watershed has long been returned to an undisturbed condition with permanent vegetative cover and with little or no land disturbance in the watershed. Internal regeneration of nutrients has been identified as the major source of nutrients to the lake. Lake destratification, selective harvesting and removal of weeds, and control of algal blooms using chelated copper sulfate application followed by potassium permanganate application have all been chosen as management techniques for improving water quality conditions in the lake. These in-lake techniques are considered not as palliative measures, but as necessary tools in enhancing the lake's water quality characteristics. (Author's abstract)
W86-00794

ENVIRONMENTAL PROTECTION IN THE REPUBLIC OF IRELAND,

Trinity Coll., Dublin (Ireland). Environmental Sciences Unit.
N. F. Gray.
Effluent and Water Treatment Journal, Vol. 25, No. 3, p 83-89, March, 1985. 1 Tab, 11 Ref, 2 Append.

Descriptors: *Environmental protection, *Ireland, *Legislation, Protection, Water pollution control, Resources management, Water management.

Water quality maintenance laws and agencies in the Republic of Ireland were evaluated. Unlike many other European countries, no single body is responsible for, or coordinates, the management of water resources. The system is local authority-based, and relies heavily on state and semi-state bodies to carry out a number of important functions. Before the implementation of the Local Government (Water Pollution) Act of 1977, three pieces of legislation, the Public Health Act of 1979, the Fisheries (Consolidation) Act of 1959, and the Local Government (Planning and Development) Acts of 1963 and 1976, were widely used in the protection of waters and public supplies. The Water Pollution Act attempts to centralize the responsibility for water resource management with local authorities, but numerous other organizations still retain various statutory responsibilties in relation to water management and pollution control. The Water Pollution Act obliges local authorities to monitor and analyze discharges and receiving water, but few are able to do so without relying on other agencies for laboratory services. Many other organizations carry on monitoring programs; at present the data are not coordinated, but eventually a catchment area-based data collection system will be instituted by local authorities. The Water Pollution Act was also designed to satisfy the legislative requirements of the European Economic Community directives, which it has successfully done to date. The Water Pollution Act is clearly adequate to protect Ireland's water resources, and overlapping sections of other acts should be repealed to eliminate duplication of responsibilities and legislative confusion. A more coordinated, catchment-based water management system, with complete control of all water functions, would appear to be the most cost-effective way for efficient water resource management, particularly pollution control. (Rochester-IVI)
W86-00813

INNOVATIVE WATER QUALITY-BASED PERMITTING: A POLICY PERSPECTIVE,

Skylonda Group, Inc., Menlo Park, CA.
D. Downing, and S. Sessions.
Journal of the Water Pollution Control Federation, Vol. 57, No. 5, p 358-365, May, 1985. 22 Ref.

Descriptors: *Permits, *Water quality, Water pollution control, Costs, Nonpoint pollution sources, Water pollution sources, Administration, Environmental effects.

The Water Innovations Project (U.S. Environmental Protection Agency, Office of Policy, Planning, and Evaluation) examined two generic types of permitting innovations: those that make greater use of the capacity of the water body to assimilate wastes, and those that encourage more efficient allocation of a given total wasteload through trading mechanisms. Innovations in the first group are seasonal permits, variable permits, seasonal standard and site-specific standards. Interplant source trades, point/nonpoint source trades, and banking comprise the second group. Cost effects, water quality eligible pollutants, and administrative issues associated with these permitting innovations were studied. All innovations would apply only where controls beyond technology-based standards are required to attain water quality standards. The innovations are most directly applicable to conventional pollutants and nutrients, not for toxics. Based on case analysis the innovations appear to provide large cost savings while protecting water quality. Administrative safeguards, such as criteria for particular pollutants when innovative permitting is used, or restrictions on situations in which innovative permitting can be employed, are needed to protect water quality and program integrity, while avoiding excessive administrative burdens. Analysis of case studies actual experience in states where these innovations are already in use indicated substantial cost savings, few if any adverse environmental effects, and manageable administrative burdens. In some states, innovative permitting broke regulatory impasses and led to earlier attainment of water quality standards than would otherwise have occurred. (Rochester-IVI)
W86-00839

CONTROL OF METAL APPLICATION RATES FROM SEWAGE SLUDGE UTILIZATION IN AGRICULTURE,

Anglian Water Authority, Huntingdon (England). Directorate of Scientific Services.
P. J. Matthews.
CRC Critical Reviews in Environmental Control, Vol. 14, No. 3, p 199-250. 4 Fig, 19 Tab, 166 Ref.

Descriptors: *Sludge disposal, *Metals, *Agriculture, *Environmental protection, Water pollution control, Fertilizers, Heavy metals, Arsenic, Boron, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Zinc, Soil, Economic aspects.

Potentially toxic metals in sewage sludge and their chemistry in the sludge medium, potentially toxic metals in normal and sludged soils, chemical controls on metal availability, and the effect of potentially toxic metals on crops and the agricultural consequences of their presence, are reviewed, and recommendations for controlling the application of sludge to land are presented. Chemical elements of interest in this field are arsenic, boron, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, and zinc. A survey of sludge disposal in the United Kingdom in 1980-81 showed that disposal of sludge on general arable land and marine dispersal accounted for more than half of the ultimate disposal of sewage sludge. The use of sewage as a fertilizer should be controlled so as to meet the following objectives: (1) avoid spread of human, animal, and plant diseases, (2) avoid public nuisance, particularly odors, (3) avoid harm to crop quality and yield resulting from soil contamination, (4) protect surface and ground waters, and (5) provide an acceptable and useful service to farmers. Application of metals to agricultural land may be controlled by limiting their concentrations in sludge, limiting their concentrations in sludge-amended soils, and limiting the rate of accumulation of metals in soil. Approaches used in deriving guidelines differ according to whether regional soils are acidic or alkaline. Industrial effluent control is an important element of controlling sludge metal concentrations; presence of industrial metals may be a factor in determining whether fertilization is an acceptable use for a particular sludge. At present, costs of removing metals from sewage sludge are prohibitive when compared to the value of the isolated metals. If the prices of metals rise, industrial discharge may decline, reducing the metal content in the sludge, thus making metal recovery from sludge less, rather than more, economic. (Rochester-IVI)
W86-00854

ALTERNATIVE APPROACHES TO ACID RAIN CONTROL,

For primary bibliographic entry see Field 6E.
W86-00867

DISSOLVED OXYGEN CONCENTRATIONS IN FLORIDA'S HUMIC-COLORED WATERS AND WATER QUALITY STANDARD IMPLICATIONS,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
T. V. Belanger, F. E. Dierberg, and J. Roberts.
Environmental Chemistry, Vol. 48, No. 2, p 107-119, 1985. 6 Fig, 5 Tab, 15 Ref.

Descriptors: *Water quality standards, *Florida, *Dissolved oxygen, *Humic-colored waters, Swamps, Lakes, Streams, Humic waters, Colored waters.

The Florida Department of Environmental Regulation (DER) has established detailed dissolved oxygen standards for the various classes of surface water in the state. According to these standards, Class III Waters (recreation) should maintain dissolved oxygen levels above 5 mg/L. Many natural humic-colored aquatic systems (lakes, swamps, and streams) rarely meet the established 5 mg/L criteria. Four sites in east and central Florida having differing degrees of humic color were investigated three or four times in one year. The 24-hr average oxygen levels at the sites varied form a summer low of 1.2 mg/L in a natural drainage marsh, to 6.0 mg/l in a man-made drainage structure. The systems are generally very undersaturated with respect to oxygen. It is believed that these conditions are natural and do not result from organic pollution. In view of this data and a brief review of the literature, it seems that the 5.0 mg/L dissolved oxygen standard for these and similar aquatic systems is unrealistic. A better approach would be to set standards based on the continued determination of the uniqueness of each system. (Moore-IVI)
W86-00901

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

ADDRESSING SOCIAL AND ENVIRONMENTAL ISSUES IN WATER RESOURCES PLANNING AND MANAGEMENT,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
W. Viessman, Jr.
Water Resources Bulletin, Vol. 21, No. 2, p 311-314, April, 1985. 2 Ref.

Descriptors: *Water resources development, *Planning, *Social aspects, *Environmental effects, Education, Public information, Management, Problem solving, Decision making.

Social and environmental goals and objectives are continually changing and often are difficult to quantify. Understanding social goals and objectives and incorporating them in water resources planning, management, education and engineering processes are keys to solving many current and emerging water resources problems. It will be necessary to instruct students, lay-persons and professionals in the importance of their involvement in the areas of goal-setting and policy-structuring, and on how to function effectively in a political-social-natural environment. The issue is how to get information on viable alternatives to decision making bodies relative to the issues with which they are concerned. The objective is to present well-informed choices, ones that are socially acceptable, technically sound and economically effi-

cient. Problem solving should be taught in the context of constraining influences, both natural and social. Findings should be presented so that those without technical expertise can understand and use them. Stronger interactions between practicing professional and the faculties of universities may lead to such objectives. Professionals must have a broad perception of the world outside their area. (Moore-IVI)
W86-00793

6B. Evaluation Process

DRINKING-WATER AND SANITATION PROJECTS: CRITERIA FOR RESOURCE ALLOCATION,

World Health Organization, Geneva (Switzerland). Div. of Environmental Health.
For primary bibliographic entry see Field 5F.
W86-00669

POLLUTANT RUNOFF MODELS: SELECTION AND USE IN DECISION MAKING,

Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5B.
W86-00780

SIMULATION AND DECISIONMAKING: THE PLATTE RIVER BASIN IN NEBRASKA,

Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
M. W. Gilliland, L. Becker, R. Cady, J. Gabig, and J. Gilley.
Water Resources Bulletin, Vol. 21, No. 2, p 281-290, April, 1985. 5 Fig, 4 Tab, 7 Ref.

Descriptors: *Water management, *Water allocation, *Platte River Basin, *Nebraska, *Simulation, *Decision making, Computer models, Water supply, Water quality, Environmental effects, Economic aspects, Instream flow, Water diversion, Agriculture, Wildlife.

Substantial conflict exists over water management and allocation in the Platte River Basin of Nebraksa. An interdisciplinary computer simulation model, representing the water quantity, water quality, environmental, and economic dimensions of the conflict, was developed in order to analyze the tradeoffs among allocation scenarios. Most importantly, decisionmakers and interest groups were involved in model development. Simulation results for a base case and two scenarios are presented. One scenario favors potection of instream flow for wildlife; the other favors waters diversions for agriculture. Impacts of the instream flow scenario, as measured by the amount of land irrigated, groundwater levels, the amount of wildlife habitat for cranes and catfish, and net agricultural benefits did not differ greatly from those of the base case. However, impacts of the diversion scenario were substantial. On the negative side, instream flows and wildlife habitat declined an average of 39%; while, on the positive side, groundwater levels and net agricultural benefits each increased 6%. The modeling process was successful insofar as it promoted an understanding among the highly diverse interest groups of the systems nature of the Basin. One agreement on a water diversion schedule among three of the parties has been reached, partly as a result of this process. More comprehensive compromises have not yet been forged. This experience, however, indicates that modeling success at the policymaking level depends more on the extent to which the policymakers understand the model than it does on model sophistication. (Author's abstract)
W86-00790

TIME AND INSTITUTIONAL REQUIREMENTS,

Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 6F.
W86-00796

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

FARMERS' ATTITUDES TOWARD NONPOINT POLLUTION CONTROL AND PARTICIPATION IN COST-SHARE PROGRAMS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 5G.
W86-00782

BARRIER TO UPGRADING FUNDING,

Purdue Univ., Lafayette, IN.
R. O. Walker, Jr.
Water Engineering and Management, Vol. 132, No. 5, p 20-28, May, 1985.

Descriptors: *Infrastructure, *Public policy, *Funding, Policy making, Decision making, Urban planning, Costs, Economic aspects, Cost allocation.

An August, 1984, workshop on 'Technical Alternatives for Urban Infrastructure' brought out several aspects of the infrastructure problem as faced by American cities. The problems of infrastructure are not merely physical, or engineering, problems, but have social, economic, community government, and regulatory aspects. Major social and economic changes, such as the change from an industrial to a service economy, mean that the demands made on the infrastructure are changing. The problem is not merely one of upgrading or repairing existing facilities, but of simultaneously adapting them to changing needs of the users. Funding for major projects is the greatest obstacle to infrastructure improvement now that federal support is being withdrawn. Aside from federal programs, funding methods that have been used include (1) revenue bonds, (2) New Jersey's infrastructure bank, from which local communities may borrow funds at low or no interest, (3) developer exactions, and (4) 'privatization' of the infrastructure. A coalition of all segments forming the framework of the urban infrastructure system and its users should be the source of the information required for the decision-making process. New methods of financing, marketing, and adoption of new technologies must be encouraged and supported. (Rochester-IVI)
W86-00797

OVERCOMING THE BARRIERS,

East Bay Municipal Utility District, Oakland, CA.
J. B. Gilbert.
Water Engineering and Management, Vol. 132, No. 5, p 28-33, May, 1985.

Descriptors: *Infrastructure, *Water conveyance, Management planning, Urban planning, Conveyance structures, Water rates, Economic aspects, Planning.

The problems of infrastructure in the water-supply systems of the United States tend to be concentrated in the older cities of Northeast, where deferred maintenance and unrealistically low water rates have created an accumulation of system problems. Four main areas that each utility manager should address before looking for assistance in resolving problems of inadequate and decaying infrastructure are: (1) an effective preventive maintenance program, (2) a capital program of replacement and improvement as part of the future planning process and annual budget, (3) an equitable water rate structure - sufficient to pay annual costs, including debt service, of a comprehensive rehabilitation program, and (4) a system of charges that places the burden of financing facility expansion on those customers causing the need. The infrastructure barriers are essentially internal to each utility. The ability to use external assistance exists, but for political and other reasons, such assistance may be severely limited in the future. As an enterprise, the water industry is uniquely capable of solving its infrastructure problem because of its particular internal ability to establish water rates that can produce a revenue stream sufficient to pay all operating costs, as well as debt service required to rehabilitate and expand deficient facilities. (Rochester-IVI)
W86-00798

ALTERNATIVE SOLUTIONS,

Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
J. J. Boland.
Water Engineering and Management, Vol. 132, No. 5, p 33-39, May, 1985. 3 Ref.

Descriptors: *Infrastructure, *Management planning, *Economic aspects, Funding, Privatization, Legal aspects, Planning.

Water/wastewater utilities with infrastructure problems are typically those in need of substantial amounts of capital. The solution to the capital problem consists of two steps: (1) increasing rates sufficiently to halt the erosion of existing capital and to provide for repayment of borrowed funds, and (2) raising needed capital from subsidies, debt proceeds, or current revenues. Within the public sector, subsidy may be disappearing as an option as federal and state government trim their budgets. Long-term debt, through such agencies as 'bond banks' or by conventional, but previously unused, debt sources is one alternative available to the utility manager. For systems with facilities in imminent danger of failure, or to keep capital costs low, short-term debt is appropriate. Sometimes market conditions may actually provide lower rates for short-term instruments. Privatization of all or part of the physical facilities is a method of financing that depends entirely on federal tax law, which provides tax benefits to those acquiring the utility. These indirect subsidies from the federal treasury may permit utilities to acquire needed facilties at a lower cost than would be possible under the public finance alternatives. Institutional changes may also help. For example, a utility could be merged with a stronger utility to provide improved credit and better cash flow. Horizontal mergers are frequently advocated to improve operational efficiency and quality of service, as well as to provide improved access to capital, whereas vertical mergers are often proposed as last-resort solutions to fiscal emergencies. (Rochester-IVI)
W86-00799

FLOTATION THAT MIGHT SINK,

For primary bibliographic entry see Field 6E.
W86-00831

BYZANTINE ART OF WATER UTILITY RATEMAKING,

Water and Wastewater Equipment Mfrs. Association, Washington, DC.
F. Summer.
Environmental Forum, Vol. 4, No. 1, p 32-38, May, 1985. 10 Ref.

Descriptors: *Economic aspects, *Water treatment, *Utilities, *Costs, Public policy, Management planning, Water distribution.

Factors affecting the setting of water rates are discussed. Water industry costs have two major sources: environmental and health-related requirements and the costs of repair and rehabilitation of facilities. Deferred maintenance is common among utilities, but nearly half of the utilities could eliminate their backlogs through stepped-up construction programs over a 10-yr period. Setting water rates involves a process of matching the costs of providing service to the unique economic, political, and social environments in which a utility provides service. Two methods are generally used for determining total revenue requirements: the case or budget basis and the utility basis. Equitable allocation of costs among customer classes required determination both of the amount of water required by each class and of the peak needs of each customer. Most rate structures used by water utilities include stepped decreases as consumption increases; different classes of customers create different load characteristics. Connection charges help finance new construction and recover some capital costs. Fire protection (hydrant) rates

depend on where a particular hydrant is located (public or private property) and who is responsible for its upkeep. Ultimately, public utility commissions control the rates for most investor-owned systems and for some publicly-owned utilities. The public and its representatives sometimes express the view that water is free, or that water rates should be limited, regardless of the utility's expense in providing it. Costs of water must reflect the benefits derived from it. (Rochester-IVI)
W86-00868

6D. Water Demand

NEW RULES FOR NATIONAL FOREST WATER,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
J. Romm, and K. Bartoloni.
Journal of Forestry, Vol. 83, No. 6, p 362-367, June, 1985. 4 Fig, 3 Ref.

Descriptors: *National forests, *Water rights, *Forests, *Legal aspects, Riparian rights, Organic Act, Federal Land Policy and Management Act, Multiple Use-Sustained Yield Act, Resource allocation, Water allocation.

The decision of the U.S. Supreme Court in the 'Rio Mimbres' case limited the federal reserved right to water, under which the Forest Service had been claiming water for all its various uses of reserved land. Based on an interpretation of the Organic Act of 1897, the court limited the Forest Service's claim to water to that necessary for maintaining timber supplies and favorable water flows. Other uses, such as recreation, fish and wildlife needs, and aesthetics, were not included. Four strategies have been employed by the Forest Service to attempt to regain lost water rights. First, a hydrological argument has been advanced, based on the 1897 Organic Act, that enough water must be allowed to flow through rivers to keep the drainage network in good condition. In California, the Forest Service has asserted its 'riparian rights' as a property owner, to which it is entitled under that states' laws. As a third strategy, the Forest Service is testing the extent of its powers to regulate private uses of national forest water under the Federal Land Policy and Management Act of 1976. Its permit authority under this act may allow it to confine the scope of private water use within national forest boundaries and to expand its control of water allocation. In a fourth strategy, the Forest Service is contending in court that the Multiple Use-Sustained Yield Act of 1960 implied the same reserved rights for 'supplemental' purposes after 1960 as the Organic Act implied for the maintenance of timber supplies and favorable stream flows. Other strategies available include exercising eminent domain power to buy water rights and various cooperative agreements with states and federal agencies for joint management of water and sharing of costs. (Rochester-IVI)
W86-00716

6E. Water Law and Institutions

NEW RULES FOR NATIONAL FOREST WATER,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
For primary bibliographic entry see Field 6D.
W86-00716

SALINITY ISSUES AND WATER DEVELOPMENT IN THE GREEN RIVER BASIN, WYOMING,
Department of Energy, Morgantown, WV. Morgantown Energy Technology Center.
S. D. Cooke, and J. Ahern.
Water Resources Bulletin, Vol. 21, No. 2, p 217-223, April, 1985. 2 Fig, 11 Ref.

Descriptors: *Water resources development, *Salinity, *Green River Basin, *Wyoming, Water allocation, Colorado River Compact, Upper Colorado River Basin Compact, Appropriation, Downstream.

Water development in the Green River Basin of Wyoming is projected to increase salinity downstream in the Green River and Colorado River, and thereby increase salinity costs to users of water from these two rivers. Despite these water quality and economic impacts to downstream water users, Wyoming will probably be able to develop its currently unused but allocated water supplies of the Green River Basin. The Colorado River Compact and Upper Colorado River Basin Compact are binding, and protect Wyoming's share of the Colorado River System waters for future use. The argument that water may be used to greater profit downstream is not sufficient to reduce Wyoming's allocation. In addition, the no-injury rule under the appropriation doctrine of law does not appear to protect prior downstream appropriations from increasing salinity in this case. (Author's abstract)
W86-00783

FLOTATION THAT MIGHT SINK,
F. Pearce.
New Scientist, Vol. 106, No. 1452, p 16-19, April, 1985.

Descriptors: *Privatization *Public policy, *Water authorities, *Organizations, *England, *Wales, Water treatment facilities, Water districts, Maintenance, Economic aspects, Infrastructure.

None of the 10 regional water authorities in England and Wales that the British government plans to sell to the private sector is without serious infrastructure problems in both the water supply and water treatment phases of its operations. The considerable age of many of the mains, reservoirs and treatment plants, and the fact that maintenance has been significantly curtailed as an economy measure since the mid-1970s, contribute to the major capital needs that these authorities have. Water supplies in many places have severe leaks, bacteriological standards are not met in some cases, Nais worms have been found in the water supply in Sussex, sewer collapses in Yorkshire (64 per 1,000 km of sewer), and problems with inadequate recordkeeping in Wales, are among the numerous problems facing the authorities involved. Many water supplies fail to meet European Economic Community standards. The water authorities (North West, Southern, Yorkshire, Thames, Welsh, South West, Severn Trent, Northumbrian, Wessex, and Anglian) have assets valued at 26 billion pounds sterling, but many of the authorities have hundreds of millions of pounds in deferred maintenance or capital spending that must be done to correct significant problems. In many areas the quality of both drinking water and effluent from treatment plants is declining rather than improving under current management. Investors may be reluctant to take on the responsibility of upgrading the seriously deteriorated facilities that would become theirs if they were to buy them from the government. (Rochester-IVI)
W86-00831

ALTERNATIVE APPROACHES TO ACID RAIN CONTROL,
E. M. Trisko.
Environmental Forum, Vol. 3, No. 12, p 18-23, April, 1985. 1 Fig, 1 Tab, 15 Ref.

Descriptors: *Acid rain, *Water pollution control, *Clean Air Act, *Legislation, Legal aspects, Air pollution, Nitrogen oxides, Sulfur dioxide, Organic compounds, Emission density zoning.

Because Section 126 of the Clean Air Act does not treat acid rain as a pollutant, downwind states have appeared to be at the mercy of upwind polluters. However, acid precipitation can be reduced by enforcing the existing Clean Air Act. At least two mechanisms are now available to EPA: a fine particulate matter standard for sulfates developed under Sections 108 and 109, and enforcement of Section 169A's visibility protection program. If Congress insists on a special legislative remedy for acid rain, existing Clean Air Act programs and principles could supply the foundation for an integrated approach to acid rain control and visibility enhancement. Compared to the emission reduction allocation methods in the principal House and Senate acid rain bills, a new approach based on emission density zoning would be more consistent both with the Act's uniform standards-based approach, and with current scientific understanding of atmospheric transport and deposition. The direction of the Clean Air Act reauthorization debate may change as a result of new evidence, indication that emissions of nitrogen oxide and volatile organic compounds may have a greater effect on forests. Eventually, Congress will have to address the major policy issue underlying the acid rain debate: whether the Clean Air Act adequately protects the environmental values Congress now intends to protect. (Moore-IVI)
W86-00867

6F. Nonstructural Alternatives

TIME AND INSTITUTIONAL REQUIREMENTS,
Interstate Commission on the Potomac River Basin, Rockville, MD.
D. P. Sheer.
Water Engineering and Management, Vol. 132, No. 5, p 14-20, May, 1985. 1 Tab.

Descriptors: *Infrastructure, *Water distribution, *Washington (District of Columbia), Simulation analysis, Computers, Water conveyance.

The value of existing water-supply infrastructure for serving current and future water-supply problems is demonstrated by the case of the Washington (District of Columbia) Metropolitan Area (WMA). Three major water-supply systems had developed to supply WMA as it grew to a population of 3 million people. By 1977, it was felt that a serious risk of supply shortfall during drought existed, and studies were conducted of several improvements to the present system, which cost $200 million to $1 billion and raised numerous objections from affected individual and agencies. A reanalysis of the operations of the individual components of the WMA distribution system, which involved three independently-operated systems, revealed that coordinated operations could make better use of available storage and Potomac River flow, and interconnections among reservoirs were proposed to facilitate this task. Further study showed, however, that no construction was needed at all, and that the existing distribution system could provide the year 2030 requirements without lowering the reservoirs below 40% of capacity. This surprising result was difficult for water managers to understand. Computer-based simulation games allowed managers and operators to grasp the concepts that analysts had had difficulty explaining. As the plan was finalized, the computer simulation model also helped resolve the issue of cost sharing, by letting each utility make its own runs under different hypothetical conditions, to test the proposed operating rules. Hundreds of simulation runs were made, using different droughts and assumptions, before the utilities were satisfied that an equitable allocation of cost had been devised. The WMA case shows how 'existing infrastructure' can be made an asset, rather than a liability needing replacement. (Rochester-IVI)
W86-00796

INNOVATIVE WATER QUALITY-BASED PERMITTING: A POLICY PERSPECTIVE,
Skylonda Group, Inc., Menlo Park, CA.
For primary bibliographic entry see Field 5G.
W86-00839

6G. Ecologic Impact Of Water Development

INVERTEBRATE COLONIZATION RATES IN THE TAILWATER OF A KENTUCKY FLOOD-CONTROL RESERVOIR,
Fish and Wildlife Service, Bowling Green, KY. East Central Reservoir Investigations.
W. D. Swink, and J. F. Novotny.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 27-34, June, 1985. 3 Tab, 17 Ref.

Descriptors: *Invertebrates, *Tailwaters, *Flood-control dams, *Kentucky, Recolonization, Aquatic insects, Oligochaetes, Dam effects, Reservoir releases, Flow discharge, Detritus, Periphyton.

The impoundment and operation of a flood-control reservoir often produce major changes in the flow regime immediately below the dam. Discharges into the tailwater are determined by the method of dam operation and downstream water requirements. In the tailwaters below some flood-control reservoirs, prolonged periods of low discharge may be followed by sustained high flows. Invertebrate colonization on newly introduced rock substrates was examined from July through October 1982 in the tailwater of Barren River Lake, Kentucky. Rock substrates were examined because they are often used as riprap in tailwaters to prevent erosion. Chironomidae, the dominant taxon of benthic insects, reached full colonization by day 14. Colonization by Oligochaeta, the other major invertebrate taxon, was not completed by the end of the 95-day period of observation. Recolonization may have been delayed because insufficient food (periphyton and detritus) had accumulated on the clean rocks. Rapid recolonization of dewatered substrates may be especially critical for maintaining adequate fish food in tailwaters of flood-control reservoirs. (Moore-IVI)
W86-00618

BENTHOS-PLANKTON RELATIONSHIP UPSTREAM AND DOWNSTREAM OF A BLACKWATER IMPOUNDMENT,

Carolina Power and Light Co., New Hill, NC. Harris Energy and Environmental Center.
D. D. Herlong, and M. A. Mallin.
Journal of Freshwater Ecology, Vol. 3, No. 1, p 47-59, June, 1985. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Benthos, *Plankton, *Reservoirs, *Black Creek, *South Carolina, Upstream, Downstream, Dam effects, Invertebrates Zooplankton, Phytoplankton, Aquatic insects, Organic matter, Particulate matter.

The phytoplankton, zooplankton, and the macroinvertebrate snag communities of Black Creek, South Carolina, upstream and downstream of an impoundment were investigated during 1982. Phytoplankton and zooplankton densities upsteam of the impoundment were very low. The reservoir outflow contributed a large part of the zooplankton of all sizes to the stream immediately below the impoundment. Large copepods and cladocerans were almost absent from the community 2.2 km downstream leaving mainly nauplii, small cladocerans, and rotifers. The reservoir also released a moderate amount of phytoplankton into the stream which was only slightly reduced further downstream. The macroinvertebrate snag community upstream of the impoundment was diverse and was dominated by the filter feeders Simulium and Rheotanytarsus. The community immediately downstream of the impoundment displayed decreased diversity and was dominated by the filter-feeding caddisflies Hydropsyche and Neureclipsis crepuscularis. Further downstream, the community showed increased diversity and a community structure resembling that above the impoundment with Rheotanytarsus dominating the filter feeders. The filter feeders above the impoundment utilized mainly ultrafine particulate organic matter (UPOM) which was probably in the form of bacteria or detritus. Immediately below, the caddisfly community utilized larger fine particulate organic matter and developed as a response to the input of large plankton entering the system. Further downstream, the return of a more diverse community utilizing UPOM paralleled the absence of large zooplankton and the retention of phytoplankton and small zooplankton in the system. (Author's abstract)
W86-00620

MODELING THE CUMULATIVE EFFECTS OF FOREST PRACTICES ON DOWNSTREAM AQUATIC ECOSYSTEMS,

Kock and Associates, Wenatchee, WA.
G. O. Klock.
Journal of Soil and Water Conservation, Vol. 40, No. 2, p 237-241, March/April, 1985. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Model studies, *Forest management, *Environmental effects, Forest watersheds, Forestry, Watersheds, Management, Water quality, Water quantity, Ecosystems, Computer models.

By modeling key watershed parameters affecting the quantity and quality of water delivered to downstream ecosystems, the KWCEA (a Watershed Cumulative Effects Analysis) model provides an annual index of a watershed's hydrologic condition. The index value implies the cumulative-effects risk that must be assumed with past, current or future watershed forest practices. Of the seven model components, only two require professional judgement - the potential slope stability failure frequency and the time period for a disturbed area within a watershed to become hydrologically mature. Guides are provided to assist in making these judgements. A computer model greatly reduces the time needed to calculate the KWCEA values. The model is particularly useful for evaluating forest practice options within a watershed during planning. Potential levels of downstream impacts can be estimated. The worst-case KWCEA index value or the implied cumulative-effects risk can be calculated and compared with present or future scheduled levels of watershed activity. The output from the KWCEA model provides a much needed data base to coordinate forest activities among several landowners within a watershed. (Baker-IVI)
W86-00651

CHANGES IN SOIL CARBON AND NITROGEN DUE TO IRRIGATION DEVELOPMENT IN NEBRASKA'S SANDHILL SOILS,

Nebraska Univ.-Lincoln. Dept. of Agronomy.
M. A. Lueking, and J. S. Schepers.
Soil Science Society of America Journal, Vol. 49, No. 3, p 626-630, May-June, 1985. 2 Fig, 5 Tab, 22 Ref.

Descriptors: *Irrigation effects, *Soil chemistry, *Carbon, *Nitrogen, *Nebraska, Hydrolyzable nitrogen, Mineralizable nitrogen, Soil depth.

Carbon and N parameters were compared for nondeveloped and developed soils (predominantly mixed mesic, Typic Ustipsamments, and sandy, mixed mesic Entic Haplustolls). Soil samples were collected from four developed center pivot irrigation sites and from the nondeveloped corners at depth increments of 0- to 75-, 75- to 150-, and 150- to 300-mm. Total C, total Kjeldahl N (TKN), hydrolyzable N, and mineralizable N by autoclave and by 112-d incubation study were determined. Changes in TKN were not significant in the 0- to 75-mm, depth, but in the second depth increment, TKN increased with development (507 to 569 kg/ha). Total C also increased at this depth (5650 to 6400 kh ha-1). The C/N ratio increased with development in the surface 75 mm (11.5 to 12.2). Inorganic N increased in the top 300 mm due to development. Mineralizable N by both techniques increased in the 75- to 150- and 150- to 300-mm depth increments. Steady state values for ln TKN were calculated to be 6.6, 6.4, and 6.8 kg/ha for soil depth increments of 0- to 75, 75- to 150-, and 150- to 300-mm, respectively. The ln total C steady-state values were 9.1, 8.8, and 9.1 kg/ha. In some cases, undeveloped soil contained more N and C than these steady-state values, suggesting that development tended to decrease the soil test values. If the undeveloped soil was lower in N or C than the steady-state value, development tended to increase the test value. Total C, TKN, hydrolyzable N, mineralizable N (both techniques), and inorganic soil N were all highly correlated. Changes in TKN and total C were not correlated to landscape position or time since development. (Author's abstract)
W86-00703

NET BENEFIT MODEL FOR RECREATION PLANNING AT DRINKING WATER RESERVOIRS,

Fitchburg, MA.
For primary bibliographic entry see Field 6G.
W86-00792

NET BENEFIT MODEL FOR RECREATION PLANNING AT DRINKING WATER RESERVOIRS,

Fitchburg, MA.
J. J. Behan, M. Gross, and L. R. Klar, Jr.
Water Resources Bulletin, Vol. 21, No. 2, p 297-309, April, 1985. 3 Fig, 6 Tab, 23 Ref. Department of the Interior project B-078-MASS.

Descriptors: *Recreation, *Environmental effects, *Reservoirs, *Model studies, *Planning, Quabbin Reservoir, Massachusetts, Water quality control, Cost-benefit analysis, Carrying capacity, Multipurpose reservoirs, Nutrients, Drinking water.

A management model was developed for determining levels of recreation activities at public drinking water reservoirs. Quabbin Reservoir, located in central Massachusetts, served as a case study for the model. An interdisciplinary research team was formed to study the impact of selected recreation activities on water quality, public demand and willingness to pay for selected recreation activities, carrying capacity constraints, and the economic cost/benefits associated with increases in recreation at the Quabbin Reservation. Study variables were integrated into a quadratic programming model, producing the number of participants that corresponds to maximum net benefits for specific development packages on design days. The reaction mix associated with maximum net economic benefits was found to be cost-effective (assuming the use of reasonable entrance fees) and not deleterious to water quality. However, as a result of the findings of a related study, it was recommended that nutrients, particularly from wastewater, not be permitted to enter the reservoir, since the current phosphorous level may be at a critical point. Management techniques that would safeguard against the occurrence were recommended. The model was sensitive to management objectives; recommendations were limited to activities that would not lower the existing high quality of Quabbin water. (Author's abstract)
W86-00792

IMPACT OF HYDRAULIC WORKS ON WATER QUALITY, PART TWO,

Electricite de France, Chatou. Direction des Etudes et Recherches.
R. Gras, and J. P. Albignat.
International Water Power and Dam Construction, Vol. 37, No. 5, p 41-46, May, 1985. 11 Fig, 1 Tab, 12 Ref.

Descriptors: *Environmental effects, *Water quality, *Hydraulic structures, Mathematical models, Navigation, Irrigation, Flood control, Ecological effects, Management.

All hydraulic projects, including those to meet quantitative needs (navigation, irrigation, and flood control) have a definite effect on the quality of water, but the magnitude of change to an ecosystem is not always related to the size of the associated hydraulic project. Appropriate design or good management of a project can limit a particular effect on the water quality, although it is necessary to have criteria to follow. Mathematical models allow the problems of conflicting criteria to be analyzed with respect to the estimation of the effects, or to the improvement of the design and selection of proper management. The actual scope for adapting management to meet water quality criteria is limited. (Moore-IVI)
W86-00802

HYDROLOGIC AND VEGETATIONAL CHANGES RESULTING FROM UNDERGROUND PUMPING AT THE CYPRESS CREEK WELL FIELD, PASCO COUNTY, FLORIDA,

Southwest Florida Water Management District, Brooksville.
T. F. Rochow.
Florida Scientist, Vol. 48, No. 2, p 65-80, 1985. 4 Fig, 2 Tab, 17 Ref.

Descriptors: *Wells, *Environmental effects, *Vegetation, *Hydrology, *Cypress Creek Well Field, *Florida, Pumping, Cypress domes, Marshes, Surface water, Aquatic plants, Wetlands.

From 1975-1982 the hydrologic and vegetation response of selected cypress domes and marshes in the Cypress Creek Well Field (Florida) to deep underground pumping was compared to similar sites far removed from water production activities. After water production began, 5 of the 7 wellfield study sites experienced 1 to 5 consecutive years without standing surface water. Control sites had some surface water each year despite differences in yearly precipitation. Wellfield study sites with at least 2 yr without surface water showed a complete loss of typical deep-water aquatic plant species such as pickerelweed (Pontederia cordata) and rush (Juncus repens). At various wellfield impacted sites, maidencane (Panicum hemitomon), willow (Salix caroliniana), blue maidencane (Amphicarpum muhlenbergianum), dog fennel (Eupatorium capillifolium) and buttonweed (Diodia virginiana) became abundant. Vegetation at the control sites was quite stable from 1 yr to the next. (Author's abstract)
W86-00899

7. RESOURCES DATA

7A. Network Design

AUTOMATIC WATER QUALITY MONITORING IN RIVERS EXPOSED TO INJURIOUS ACTIVITIES,

National Board of Waters, Helsinki (Finland).
For primary bibliographic entry see Field 5A.
W86-00671

GENERAL LAKE WATER QUALITY INDEX,

National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 2H.
W86-00673

DENSITY OF PRECIPITATION CHEMISTRY NETWORKS,

Kozponti Cegkorfizikai Intezet, Budapest (Hungary).
L. Haszpra.
Environmental Monitoring and Assessment, Vol. 5, No. 2, p 185-197, June, 1985. 4 Fig, 2 Tab, 13 Ref, 1 Append.

Descriptors: *Precipitation chemistry, *Density, *Network design, Sulfates, Nitrates, Ammonium, Calcium, Water pollution sources, Mathematical models, Statistical models.

Using a mathematical-statistical method the accuracy of the precipitation chemistry networks of different densities were studied. The necessary density of the networks was estimated. The basic principle of network planning methods is the following: the meteorological network covering a given area has to make it possible to determine the value of the meteorological element for any point or any part of the area with the required accuracy. The error of the interpolation for any point or that of the areal averaging for any part of the area must not exceed the maximum value permitted by the investigations. Using Scandinavian precipitation chemistry data the dependence of the accuracy of the interpolation and areal averaging of sulfate, nitrate, ammonium ion and calcium ion contents of precipitation water on the density of the network and on the size of the area considered is studied. The density of networks operation with a given accuracy can be determined as a function of the area. As an example the density of the networks determining the annual and mothly areal SO4(-2) deposition as well as the point values of the monthly SO4(-2) concentration with an accuracy of 1%, 25% and 30%, respectively is calculated. The accuracy provided by such networks for other components in precipitation water is also studied. (Baker-IVI)
W86-00684

ENVIRONMENTAL AUDIT. II. APPLICATION TO STREAM NETWORK DESIGN,

Minnesota Univ., St. Paul. Dept. of Forest Resources.
J. A. Perry, D. J. Schaeffer, H. W. Kerster, and E. E. Herricks.
Environmental Management, Vol. 9, No. 3, p 199-207, May, 1985. 5 Tab, 22 Ref.

Descriptors: *Environmental audit, *Network design, *Streams, Idaho, Sampling, Data acquisition, Data interpretation, Water quality, Decision making, Monitoring, Planning, Management.

The planning and execution of water quality management programs requires careful collection and analysis of data coupled with a systematic review and analysis of programmatic success. The environmental audit is a tool which facilitates improved water quality planning and management. This article demonstrates the utility of the environmental audit by reviewing portions of a comprehensive review of the water quality management program for the state of Idaho. The audit is a tool which forces careful design of a sampling program before data are collected. In the audit approach, program objectives are clearly stated prior to initiation of sampling. Stated objectives are also evaluated regularly to identify tension points, that is, conflicts between expectations and reality. In the example taken from Idaho, a management review team followed a directive to redesign the water quality monitoring program. A summary of the redesign as proposed by that team is presented to illustrate the results of a typical review of monitoring programs. That summary is followed by an example of how the proposed program would differ if the audit approach had been used. The two approaches offered both coincident and conflicting recommendations. Management review team and audit recommendations for lake sampling programs were similar even though a different process was used to develop the recommendatons. The most striking contrast between the two results lies in the review team's approach to the problem. The directives followed, and the team's responses, concentrate on tools, such as increasing biological monitoring or reliance on monthly BWMP stations. In contrast, the audit results stress addressing management questions for which clear objectives have been stated, depending on specific tools only as needed to meet stated objectives. Although the audit does integrate externalities in its structure, it is little affected by economic or political influences. A major strength of the audit approach is its ability to provide defensible data for management decision making. (Author's abstract)
W86-00723

7B. Data Acquisition

DETERMINATION OF MOISTURE IN SOLIDS,

Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 2G.
W86-00644

SURFACE SOIL WATER CONTENT MEASUREMENT USING PULSED NUCLEAR MAGNETIC RESONANCE TECHNIQUES,

Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2G.
W86-00698

USE OF SEEPAGE METERS TO ESTIMATE GROUNDWATER NUTRIENT LOADING TO LAKES,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
T. V. Belanger, and D. F. Mikutel.
Water Resources Bulletin, Vol. 21, No. 2, p 265-272, April, 1985. 3 Fig, 6 Tab, 22 Ref.

Descriptors: *Seepage meters, *Nutrients, *Lakes, *Seepage, Groundwater movement, Nitrogen, Phosphorus, Lake sediments, East Lake Tohopekaliga, Florida.

Data from a study on East Lake Tohopekaliga, Florida, indicate that the seepage meter measurement method may often overestimate nutrient contributions to lakes. Nutrient loading data from this method and a method employing lakeside piezometer nutrient data and seepage meter flows were not comparable. Seepage nutrient loading from the meter and piezometer methods comprised 39 and 18% of the nitrogen budget and 38 and 9% of the phosphorus budget, respectively, for East Lake Tohopekaliga. In terms of water, groundwater seepage accounted for only 14% of the total input to the lake. It is felt that some of the past studies using the seepage meter method to estimate nutrient loading may be in error due to reasons related to the enclosure of lake sediments by the meter and the accompanying anaerobic conditions which quickly result. (Author's abstract)
W86-00788

REMOTE DETECTION OF GROUNDWATER CONTAMINANTS USING FAR-ULTRAVIOLET LASER-INDUCED FLUORESCENCE,

Tufts Univ., Medford, MA. Dept. of Civil Engineering.
W. A. Chudyk, M. M. Carrabba, and J. E. Kenny.
Analytical Chemistry, Vol. 57, No. 7, p 1237-1242, June, 1985. 6 Fig, 2 Tab, 16 Ref. NSF grant PRM-8114621.

Descriptors: *Groundwater contamination, *Remote sensing, *Fluorescence, *Pollutant identification, Phenol, Cresol, Toluene, Chlorophenol, Nitrophenols, Xylenes, Detection limits, Humic acids.

Remote fluorescence analysis of groundwater contaminants by using UV lasers and fibers optics was successfully tested. Several priority pollutants (phenol, o-cresol, toluene, o-chlorophenol, p-nitrophenol, 2,4-dinitrophenol, and xylenes) as well as naturally occurring humic acid, at environmentally significant concentrations, were readily detected by using the technique. At an instrument/analyte distance of 25 m, which equals or exceeds the depth of many aquifers used as drinking-water supplies, individual compounds had detection limits at or below the parts per billion level. Phenolic and humic acid contaminants in actual landfill and barkpile leachates were easily detected at 25 m after 10,000-fold dilution. Practical problems in implementing a UV-laser-based system, such as efficient coupling, fiber damage threshold (approximately 15 MW/sq cm), scattered light, shape of response curve, etc., have been examined and simple solutions demonstrated. (Author's abstract)
W86-00818

MICROARRAY ELECTROCHEMICAL FLOW DETECTORS AT HIGH APPLIED POTENTIALS AND LIQUID CHROMATOGRAPHY WITH ELECTROCHEMICAL DETECTION OF CARBAMATE PESTICIDES IN RIVER WATER,

Georgia Univ., Athens. Dept. of Chemistry.
J. L. Anderson, K. K. Whiten, J. D. Brewster, T.-Y. Ou, and W. K. Nonidez.
Analytical Chemistry, Vol. 57, No. 7, p 1366-1373, June, 1985. 6 Fig, 3 Tab, 47 Ref.

Descriptors: *Electrochemical flow detectors, *Liquid chromatography, *Carbamates, *Insecticides, Chromatography, Microarray electrodes, Solid electrodes, Kelgraf, Pesticides, Chemical analysis.

The properties and advantages of microarray electrodes are discussed relative to solid electrodes as flow detectors. Amperometric response for a series of Kelgraf microarray electrodes of varying percent graphite is in agreement with theoretical predictions. The Kelgraf electrode effectively discriminates between oxidation reactions limited by the rate of mass transport and reactions (including solvent oxidation) limited by the rate of electron transfer or other surface processes, affording improved detection limits at high applied potentials. The advantages are illustrated for measurement of carbamate pesticides spiked into a river water matrix, using liquid chromatography with electrochemical detection. Subnanogram detection limits

(in the 50-430-pg range) are obtained in all cases with minimal sample cleanup or pretreatment, with as much as 60-fold improvement over other reports for glassy carbon or alternative LC detectors in the best cases. The relative magnitudes of pesticide current response at Kelgraf and glassy carbon electrodes under identical conditions are consistent with theoretical predictions, while enhancements in the signal/noise ratio are slightly lower than expected. (Author's abstract)
W86-00820

7C. Evaluation, Processing and Publication

GEOGRAPHIC INFORMATION SYSTEMS FOR NATURAL RESOURCE MANAGEMENT,
Oklahoma State Univ., Stillwater. Center for Applications of Remote Sensing.
S. J. Walsh.
Journal of Soil and Water Conservation, Vol. 40, No. 2, p 202-205, March/April, 1985. 4 Fig, 10 Ref.

Descriptors: *Water management, *Maps, *Resources development, Remote sensing, Planning, Runoff, Model studies, Data processing.

The ability to turn analog information into digital data and then to edit, store, and display the data as maps or color images has a variety of applications in resource management and regional planning. Land use planners, engineers, agriculturalists, and many others use maps or images displaying soil type, geology, land use, hydrology, and other natural resource data on a daily basis. The advantages of archiving these data in a geographic information system include ease of retrieval, variety of output products to fit almost any need, and the ability to discover and display information gained by testing the interactions between natural resources phenomena and to organize and appraise variable coefficients for predictive models. A need exists to estimate runoff as a function of soil, vegetation, and antecedent moisture and to simulate physically based elements on the natural system on a temporal and spatial basis. Organizing data in a geographic information system permits the appraisal of nonpoint pollution over extensive areas and on a repetitive schedule. Such a system also provides a framework for identifying and managing areas that contribute in relative amounts to the runoff problem. (Baker-IVI)
W86-00649

8. ENGINEERING WORKS

8A. Structures

STATE OF THE ART ON THE DIMENSIONING OF SPILLWAYS FOR DAMS, APPENDIX: CROSSED JET SPILLWAYS (ETAT DES CONNAISSANCES SUR LE DIMENSIONNEMENT DES EVACUATEURS DE CRUE DES BARRAGES, ANNEXE: EVACUATEURS A JETS CROISES),
Hidroprojecto, Lisbon (Portugal).
A. Lencastre.
Houille Blanche, No. 1, p 19-52, 1985. 19 Fig, 3 Tab, 79 Ref.

Descriptors: *Spillways, *Design criteria, *Crossed-jet spillways, Turbulent flow, Energy dissipation, Scour, Hydraulic design, Intakes.

A summary is given of the state-of-the-art on the dimensioning of spillways, having in mind their evolution and analyzing : the intake components; the zone upstream of the intake as far as the energy dissipation; the dynamics of the jets; turbulent pressures in lined stilling basins; the scour process. Lastly, a theoretical and experimental study is made on the effect of the shock between the descending jets of the surface spillways and the ascending jets of the bottom jets - crossed jets - results being presented that make it possible to estimate the reduction in the scour potential of the whole discharge. (Author's abstract)
W86-00655

WHAT'S GOING ON UNDER CHICAGO,
De Leuw, Cather and Co., Chicago, IL.
E. McGuire.
Pollution Engineering, Vol. 17, No. 2, p 29-32, February 1985. 2 Fig.

Descriptors: *Chicago, *Calumet Pumping Station, *Illinois, *Tunnels, *Pumping stations, Pumps, Sewers, Main sewers, Wastewater facilities, Water transport.

The Calumet Pumping Station, a part of the Chicago (Illinois) Tunnel and Reservoir Plan (TARP), uses six computer-controlled centrifugal pumps with a combined capacity of 280,000 gallons per minute (gpm) to deliver wastewater at a suction head varying from +5 to -322 ft Chicago City Datum. Unlike a conventional lift station, the Calumet Pumping Station, which will go on line in early 1985, will discharge directly into the sewage treatment works, and has been designed to function on flow demand rather then maintenance of a wet shaft water level. The system includes two pump rooms, located 350 ft below grade, interconnecting shafts and an electric substation, and various above-ground support facilities. The pumps selected include two types: four with infinitely variable-speed transmissions coupled to 6,000 horsepower (hp) synchronous motors, with rotation speeds from 0-600 revolutions per minute, and two constant-speed units driven by 2,500 hp induction motors. The control system allows operation automatically from a remote control room, manually from the same control room, or locally from control panels located adjacent to the equipment being controlled. Six ultrasonic flow meters provide continuous flow measurements to computers, which govern the system and record 44 separate functions, each of which can be assigned to trend recorders for analysis as part of the preventive maintenance program. Quick-closing valves (84 inches in diameter) are provided for security against flooding of the pump room, and fire, hazardous gas, and oxygen deficiency are monitored, with automatic responses to an emergency programmed into the controls of support systems. Trash removal is by bar screens, screen rakes, and skip hoists, with disposal off site. A 16-foot diameter equipment shaft is provided for each pump room, with a 40-ton capacity overhead crane for moving equipment. (Rochester-IVI)
W86-00767

LARGE-DIAMETER FLEXIBLE STEEL PIPES FOR THE TRANSFER WORKS OF THE KIELDER WATER SCHEME,
Babtie, Shaw and Morton, Glasgow (Scotland).
For primary bibliographic entry see Field 8G.
W86-00832

SUPERHYDRO,
A. Danilevsky.
Civil Engineering, Vol. 54, No. 11, p 54-57, November, 1984. 1 Fig.

Descriptors: *Hydroelectric plants, *Pumped storage, *Dams, *Bath County, *Virginia, Reservoirs, Tunnels, Electric power production.

When the Bath County (Virginia) Pumped Storage Project is completed in 1986, it will be the world's largest, with six turbine/pump generator/motor units rated at 2,100 Mw. Bath County is in the James River basin, high in the ridges and valley of the Appalachian Mountains. Conduits in rock connect the upper lake to the lower one with a drop of about 1,200 ft from the upper lake to powerhouse over a more than 8,000 ft route. Two dams are involved, both of earthfill/rockfill type with impervious cores. The upper dam is 460 ft high and 2,200 ft long; the lower dam is 150 ft high and had a spillway designed to carry 38,000 cu ft/sec. The reinforced concrete powerhouse is designed to resist being submerged to 6 ft above its roofline, with only the parapet protecting it from flooding. The main generator hall contains six bays, each with a reversible turbine/pump connected to a reversible generator/motor unit. Each unit has a rated 3,350 Mw generating capacity at a rated 1,262 ft head and required 410 Mw when reversed. A 500 kv switchyard is on the roof deck, and nine 300 Mva transformers are upstream in the powerhouse yard. Three 28.5 ft diameter tunnels lined with 18 in concrete will be used to connect the upper and lower reservoirs. A 986-ft vertical shaft about midway along the tunnel accounts for most of the vertical drop to save excavation costs. Surge chambers, located just upstream from the vertical shafts, are 330 ft high and 44 ft in diameter. (Rochester-IVI)
W86-00883

ITAIPU, SOUTH AMERICA'S GRANDE DAME,
Itaipu Binacional, Rio de Janeiro (Brazil).
J. R. Cotrim, H. W. Krauch, and G. S. Sarkaria.
Civil Engineering, Vol. 54, No. 12, p 40-43, December, 1984. 2 Fig.

Descriptors: *Itaipu, *Brazil, *Paraguay, *Parana River, *Hydroelectric plants, *Hollow dams, Costs, Dam construction, Construction costs, Dams.

The world's highest and largest hollow gravity dam was built at Itaipu, on the Parana River between Brazil and Paraguay. The structure is 643 ft high and 25,400 ft long. Key elements in the success of the project were timely diversion of the river through a single diversion channel, which prevented an 8-mo delay in construction that would have cost $300 million in interest charges, construction of suitable cofferdams of 295 ft and 246 ft high, and maintenance of minimum flow as the reservoir filled. The selection of the hollow gravity design saved 2.1 million cubic yards of concrete compared to a solid gravity design. An unexpected combination of flooding conditions necessitated changes in the planned filling procedure; all 14 spillway gates, each 65.6 x 70 ft, were opened 15 days after storage began. The Itaipu spillway will be required to operate continuously until more power units can be installed. The maximum spillway discharge so far has been 1,348,000 cu ft/sec, 61% of the design capacity. Two 700 Mw generating units became operational in 1984; all 18 units will be operational in 1990 when the project capacity will be 12,000 Mw. The Itaipu project, when completed, is estimated to cost $15 billion (1983 dollars), of which about 36% is for interest and financial charges. The system will operate as a base-load power plant with very little drawdown, which will ensure high operational efficiency and low maintenance costs. (Rochester-IVI)
W86-00886

PROPORTIONAL WEIRS FOR STORMWATER POND OUTLETS,
EGC-Southwell, Inc., Englewood, CO.
A. Sandvik.
Civil Engineering, Vol. 55, No. 3, p 54-56, March, 1985. 4 Fig.

Descriptors: *Weirs, *Proportional weirs, *Storm runoff, *Detention reservoirs, Construction, Costs, Flood protection, Dams.

A proportional weir to control outflow from a stormwater pond near Denver, Colorado, provides a way to restrict floodwater release from a developed site to historic flows, thus preventing downstream property damage and resulting legal claims. The proportional weir uses an outlet that decreases in width towards its top, with cross-sectional dimensions adjusted so that there is a linear relationship between head and discharge. The weir was sized based on the maximum head available in the pond and the maximum discharge that the weir was allowed to pass (100-yr historic). The approximate maximum storage volume for the stormwater pond was found by determining the areas between the historic and post-development storm hydrographs. The proportional weir outlet structure was constructed of reinforced concrete, with each side supported by a counterfort extending perpendicular to the weir in the upstream direction. The weir edge was constructed by bending two steel channel sections to the dimensions outlining the weir.

An energy dissipator consisting of 18-24-in riprap was placed immediately downstream, depressed 4 ft. In 1982, the weir cost $43,000, with an additional $118,000 required for a flashboard dam. Cost of grading the detention pond was additional. (Rochester-IVI)
W86-00887

HYDRAULIC FILL DAM MADE EARTHQUAKE RESISTANT,

East Bay Municipal Utility District, Oakland, CA.
H. J. Billings.
Civil Engineering, Vol. 55, No. 6, p 56-59, June, 1985. 4 Fig.

Descriptors: *Hydraulic-fill dams, *Earthquake engineering, *San Pablo, *California, Dams, Geologic faults, Construction criteria, Buttress dams.

An earthfill buttress, combined with a sand (drain) blanket, was used to protect the dam at the San Pablo (California) reservoir from the potential effects of earthquakes. The dam, built in 1919-21 by hydraulic fill methods, lies relatively close to the active Hayward, Calaveras, and San Andreas faults. Of 20 originally studied construction alternatives, seven were considered feasible: an upstream rockfill buttress, a new dam at one of three locations, an upstream earthfill buttress, a replacement of the existing dam, and a partial replacement of the existing dam. The upstream fill buttress was not only the most economical, but was most desirable from engineering and environmental viewpoints. To install the 50-60 ft-thick buttress, the reservoir had to be dewatered. Water supply was ensured by constructing a temporary pumping plant and a temporary pipeline running along the reservoir shoreline and into the raw water line below the reservoir. The discovery that porewater pressures equal to 100% of the amount required for liquefaction could occur during an earthquake both within the dam and within the impervious buttress necessitated installation of drains. A 3 ft-thick sand blanket was installed, complete with three new vertical vents, between the dam and the new buttress, to ensure that pore pressures would be released into the reservoir. Vertical sand drains were also drilled within the original dam cross-section. The project cost $16.4 million, of which $3.3 million was for the bypass waterway system. (Rochester-IVI)
W86-00888

8B. Hydraulics

MODELLING VIBRATION AND VORTEX FORMATION AT PIEDRA DEL AGUILA,

Ecole Polytechnique Federale de Lausanne (Switzerland). Lab. d'Hydraulique.
J. Bruschin.
International Water Power and Dam Construction, Vol. 37, No. 5, p 21-24, May, 1985. 9 Fig, 4 Ref.

Descriptors: *Vibrations, *Vortices, *Piedra del Aguila, *Dams, Service gates, Cavitation, Spills.

Model tests were used to successfully define and correct vibration and vortex formation problems associated with the Piedra del Aguila dam. The Piedra spillway uses 15 x 18.5 m radial gates and 3 x 2 m maintenance and service gates at the bottom outlet. Runs with the spillway on the general 1:130 model demonstrated active, partly air-entraining, vortices in the inlet bays upstream from the spillway crest. Observations were conducted and vortices were ranked in terms of strength, size, and persistency, scale effects were estimated, and vortex-suppressing measures were proposed and tested. Modification of bay or pier shape was eliminated as a potential solution after testing, but vortex-suppressing collars around the pier heads efficiently suppressed the vortices. A boundary layer suction device also was designed and tested. Testing at scale 1:25 showed that the device worked smoothly if well submerged, even under rather high heads. Systematic tests were conducted with the service gate opened at 31.49% and 77% of the total aperture while the maintenance gate was progressively lowered, because this operational procedure seemed most likely to uncover vibration and cavitation risks according to the results of earlier tests. Large sub-atmospheric pressures with important fluctuations (standard deviation = 1/3 of the average pressure value) were found between the two gates. It was observed, however, that a very small displacement of the maintance gate produced an abrupt change in the pressure pattern, so this condition was discarded from the list of high-risk situations being considered. (Rochester-IVI)
W86-00800

SIMPLE GOVERNING AND SURGING SIMULATION, PART ONE,

Queen's Univ., Kingston (Ontario). Dept. of Mechanical Engineering.
R. A. Chaplin.
International Water Power and Dam Construction, p 25-28, May, 1985. 2 Fig.

Descriptors: *Surges, *Governing stability, *Turbines, *Simulation, Mathematical equations, Hydroelectric plants, Hydraulic transients, Computers.

This article considers the governing stability of hydro turbines and the hydraulic transients in waterways following various changes in operating conditions. The appropriate mathematical equations are derived to give the necessary background for an overall understanding of the formulation of the expressions and physical phenomena. The equations are then put together to create a simple but effective method of determining the overall transients occurring in hydro powerplant following a disturbance. The resultant computer program (to be published in Part Two) can be used on any desk top computer to study various elementary transients. The emphasis is on simplicity since the program lends itself by expansion, to reasonable degree of elaboration. (Author's abstract)
W86-00801

8C. Hydraulic Machinery

HYDRO-PLANT UPGRADES YIELD RELIABLE, COST-EFFECTIVE KILOWATTS,

J. Makansi.
Power, Vol. 129, No. 5, p 61-63, May, 1985. 6 Ref.

Descriptors: *Hydroelectric plants, *Costs, *Upgrading, Capacity, Power plants, Turbines, Generators, Maintenance.

Older hydroelectric plants often have additional capacity available if steps are taken to upgrade equipment to the best modern standards. Efficiency of turbine runners may be improved by replacing carbon steel runners with those made of stainless steel (integrally cast). Uprating of a turbine/generator usually means more water flow through the unit, which generates a requirement for upgrading of other elements, such as wicket gates, seals, and operating procedures intended to balance runner cavitation, output, and minimum tailwater elevation. The Electric Power Research Institute and others recommend that generator stator windings be subjected to a comprehensive program of dielectric measurements, supplemented by visual inspections at regular intervals, so that trends in performance and condition can be used to predict when rewinding is necessary. Uprating a turbine/generator may necessitate improving of coupling bolts, rotor hubs, spider assemblies, and shafts because these components may be subjected to greater stresses and thermal loads. The thrust bearing load should also be examined when upgrading a system. Modern instrumentation provides many more measurements than are normally offered with older systems. (Rochester-IVI)
W86-00804

EVALUATING PUMP CHARACTERISTICS IN DEVELOPING COUNTRIES,

North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. Briscoe.
Civil Engineering, Vol. 54, No. 11, p 58-61, November, 1984. 1 Tab, 7 Ref.

Descriptors: *Pumps, *Developing countries, *Evaluation, Pump testing, Performance evaluation, Training, Algorithm.

Using theoretical considerations, forms were developed to relate pump parameters (eg, revolutions per minute, impeller diameter, and discharge pipe diameter) to pump performance characteristics (flow and head), and the results were presented in a table. Pump types included in the table are manual reciprocating, motor-driven reciprocating, simple centrifugal, multistage pumps (including turbine pumps for boreholes), helical rotary borehole pumps, and hydraulic rams. Formula for calculating electric and diesel motor sizes are provided also. For each type of pump in the table, an example calculation is worked using the table information, with each step in the calculation included. The table should be useful to those water personnel in developing countries who have experience with the approximations and limitations involved in this type of performance estimation. For water technician training, the approach used here can be adapted to the types of pumps used in particular regions. (Rochester-IVI)
W86-00884

8E. Rock Mechanics and Geology

SEISMIC MICROACTIVITY AND WATER LEVEL VARIATION IN INDUSTRIAL AREA NEAR FLORENCE (ITALY),

Florence Univ. (Italy). Ist. di Geologia e Paleontologia.
For primary bibliographic entry see Field 2F.
W86-00632

HYDROGEOLOGICAL PROSPECTING GROUP AND TYPES OF MINERAL DEPOSITS FILLED WITH KARST WATER IN CHINA (IN CHINESE).

For primary bibliographic entry see Field 2F.
W86-00897

8G. Materials

LARGE-DIAMETER FLEXIBLE STEEL PIPES FOR THE TRANSFER WORKS OF THE KIELDER WATER SCHEME,

Babtie, Shaw and Morton, Glasgow (Scotland).
N. S. M. Berry, F. M. Forsyth, and J. Temporal.
Journal of the Institution of Water Engineers and Scientist, Vol. 39, No. 2, p 113-133, April, 1985. 14 Fig, 2 Tab, 12 Ref.

Descriptors: *Pipelines, *Kielder Water Scheme, *England, Pipes, Conveyance structures, Construction methods, Construction materials, Steel, Stress, Materials testing.

A large-diameter pipe was selected and installed for the pumping main (2,020 mm outside diameter) and aqueducts crossing the Wear and Derwent Valleys (2,890 mm inside diameter) and is intended to transfer water as part of a flow augmentation scheme for the River Tees (northeastern England). Design requirements included the ability to operate at either 'normal' pumping level (546 million liters/day) or 'abnormal' pumping level (942 millior liters/day). In addition to hydraulic pressures pipes were chosen to withstand handling and th effects of both transverse and radial external loads which could act on the buried pipes. Pipe deflec tion and stress measurements were obtained fo finished sections. Installation had to take into ac count the problem of possible floating of the empt pipe as it crossed floodplains at below river leve Spirally-welded steel pipe was the only practic choice of material; 43A and 50B steels were use and a special joint, the Babtie/Byard joint, w designed for this pipeline. Ultimately, the pipe w given a cement mortar lining, which was almo entirely placed by machine because of careful a tention to pipe joint details. Trench bottoms we precompacted, and graded crushed limestone f was used to achieve suitable support for the pi

because none of the local materials was suitable for refilling the excavation. Movement of machinery across the pipe was controlled, although there were breaches of the rules, which did cause pipe deflections. There was reasonable agreement between field measurements and theoretical predictions of flexible pipe design method. The maximum recorded stress was some 40% of the yield stress of mild steel. Deviation of the pipe was limited to + or - 2% to enable cement mortar lining. Consequently, the buckling limit of the pipe is not likely to be reached; the minimum factor of safety against buckling is 3. Some pipes were pre-deflected prior to installation. This approach was useful in limiting the final eccentricity of the buried flexible pipes, but installing of props caused some problems. (Rochester-IVI)
W86-00832

8I. Fisheries Engineering

DISTRIBUTION PATTERN OF DENITRIFYING BACTERIA IN FISH PONDS OF DIFFERING FARMING MANAGEMENTS,
Kalyani Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-00622

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New Alchemy Inst., East Falmouth, MA.
For primary bibliographic entry see Field 2H.
W86-00664

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Finnish Game and Fisheries Research Inst., Helsinki. Fisheries Div.
For primary bibliographic entry see Field 2H.
W86-00678

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Kuopio Univ. (Finland). Dept. of Occupational and Industrial Hygiene.
For primary bibliographic entry see Field 5B.
W86-00680

SEPARATING STARVATION LOSSES FROM OTHER EARLY FEEDING FRY MORTALITY IN STEELHEAD TROUT SALMO GAIRDNERI, CHINOOK SALMON ONCORHYNCHUS TSHAWYTSCHA, AND LAKE TROUT SALVELINUS NAMAYCUSH,
New York State Dept. of Environmental Conservation, Albany. Bureau of Environmental Protection.
For primary bibliographic entry see Field 5C.
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